9-22-2017

Re-envisioning Kindergarten Learning Spaces in the U.S Education System

Suhina Agarwal
sa9505@rit.edu

R.I.T

Re-envisioning Kindergarten Learning Spaces in the U.S Education System

by

Suhina Agarwal

A Thesis Submitted in Fulfillment of the Requirements for the Degree of
Master of Fine Arts

The School of Design
Department of Industrial Design

Rochester Institute of Technology
Rochester, NY
September 22, 2017

Committee Members:

1. Alex Lobos - Graduate Director, Industrial Design
2. Stan Rickel - Associate Professor Design, Industrial Design
3. Gary Molinari - Lecturer Design, Industrial Design
4. Susan Northup - Kindergarten Teacher, Margaret's House

Table of Contents

Abstract

The thesis work aims at improving the learning environments of the Kindergarten classrooms in the United States by taking inspiration from a very simple and popular play element namely the 'blocks'. The classroom environments and learning methods have not seen a significant change since the time of the Industrial Revolution. The essence of school education remains the same, which is expected to be a closed classroom, conventional furniture and the teacher determining the learning activities. With the changing times, as new studies on multiple styles of learning and brain functions emerge, there is a need to customize education and cater to every individual's need as everyone learns differently.

Classroom learning is heavily dependent on the furniture being used, and if the furniture is big and bulky, the teachers and students become restricted in their movement, which also confines learning. The thesis aims at reversing this effect. Rather than furniture dictating the classroom education, the thesis looks at making the furniture flexible enough to accommodate all kinds of activities and support multiple learning styles. Furniture integrated with play blocks makes the environment playful, exciting, provides for flexible learning and free movement; and in the process, accommodates different learning styles.

Keywords: Education, Flexible Learning, Multiple Learning Styles, Flexible Furniture, Play Based Learning

1. Introduction To Education

'The act or process of imparting or acquiring general knowledge, developing the powers of reasoning and judgment, and generally of preparing oneself or others intellectually for mature life.'

Education can be formally defined as the statement written above (Source: Dictionary.com). However, over time the definition, meaning and practice of Education has changed tremendously. With so many terms involved in its definition such as 'acquiring general knowledge', 'developing powers of reasoning and judgment' and 'preparing oneself for mature life', the term 'Education' becomes rather subjective as each term has a different interpretation and meaning for every individual. Mature life for one might differ from the mature life for the other. How do we, in such a case, establish an interpretation of the term 'Education' that is meaningful and comprehendible by everyone? One way could be to look at Education as the process that aims at raising healthy, happy individuals who grow to become contributing members of families and society. Of all the definitions of Education that have been coined to date, the one that resonates with me the most is **'**Education is the key to success in life, and teachers make a lasting impact in the lives of their students.' (Solomon Ortiz, 1937-, former U.S. Representative-TX), where 'success' is subjective and can differ in its meaning from one individual to another, but Education gives them the power and skill to discover this meaning and use it in life to achieve the success they want to. That said, the importance and advantages of education cannot be underestimated.

1.1 Advantages of Education[1]

a. Leading a happy and stable life

Education promises a secure future and stability in life. While the reasons for one's happiness may be materialistic or emotional, education helps achieve both in one way or the other. A satisfactory job, a reputable image in the society, a good social circle etc. are some of the benefit that come with education.

a. Equality

Education can be the tool that gives equal opportunities to all the individuals in the world irrespective of their gender, religion, race or caste. If everyone is given the power of knowledge, everyone gets an equal shot at the well-paying jobs and other opportunities the world has to offer, hence eradicating any boundaries between social classes and genders.

b. Independence

Education gives us the power to be independent at what we do and how we earn. Educated individuals do not need to depend on others for their job or other amenities for living. Also, in the times of crisis, educated people are wise and aware and can make their own decisions in life.

c. Money

Money might be the reason of several problems in society today, but one can't ignore the fact that it is essential for living a good life, one where we can fulfill all our desires. Educated people have better chances

---

[1] Mohamed Reda, 'Top 10 Reasons why Education is Extremely Important', published on April 9, 2015 https://www.linkedin.com/pulse/top-10-reasons-why-education-extremely-important-mohamed-reda/

Kavya Vidyarthi, 'Top 15 Reasons Why Education is Extremely Important' published on September 1, 2015 https://listsurge.com/top-15-reasons-education-important/

to wind up with better living as they have the knowledge and social skills to land better jobs and hence earn better!

d. Health

'A healthy mind resides in a healthy body'. Educated individuals have better knowledge about the benefits of staying healthy, diseases and their prevention and advantages of immunization. They can also take better care of their offspring by passing on this knowledge and taking early measures in prevention of diseases by providing them with appropriate immunization.

e. Fulfilling Dreams

Education aids us in identifying our dreams, aims and goals in life and helps fulfill them. Be it owning your favorite car or gaining fame, education would always be used at some point or other in the journey.

f. Personal Traits

An educated person would be confident, alert and wise. He would listen to everyone carefully but be smart enough to make the decision best for him. This boosts confidence and makes him capable of handling different situations. An educated person would also choose rationale over superstition or assumption.

g. Development of Society

An educated person has better chances of contributing towards the betterment of society and serving the community well. He is aware of the problems going on around him and can contribute to the same. In an ideal world, where everyone is educated, people would have more constructive goals to achieve for the development of society and there would be no wars.

h. Economic Growth of Nation

Education is crucial for development of economic growth of a nation. 'Australia, USA and Japan are a few countries with very high literacy rates. These countries are extremely prosperous and citizens have a high per capita income. On the other hand, in underdeveloped and developing nations, where literacy rate is not as high, numerous people are still living below the poverty line.

1.2 Problems with the current Education System [2]

The need of the hour is an Education system that is exciting, engaging and makes students look forward to learning new things. However, the Education system unfortunately is still a 'One-size-fits-all', 'Factory Manufacturing' system where students are treated as products that need to be trained, produced, labeled and sent out into the world, according to their intelligence measured through tests and examinations that do not accommodate for their individuality and learning styles. With the new advancements in the world, some of which have never been seen by the human race before, there is a need to modify the Education System and the way of learning by utilizing the current tools and techniques instead of the outdated ones and preparing the children about the futuristic developments. Some of the factors that are failing the education system from meeting the needs of the constantly evolving society are:

---

[2] Matthew Lynch, '10 Reasons the U.S Education System is Failing', published on August 27, 2015 http://blogs.edweek.org/edweek/education_futures/2015/08/10_reasons_the_us_education_system_is_failing.html

Andy Powell, 'We Need An Education System That Excites Children', https://www.teachingtimes.com/articles/revolution-education- system.htm

Lack of Parental Involvement

It becomes difficult for the teachers, especially in overcrowded classrooms, to give individual attention to all the children. This is where the role of parents steps in, in post school hours. Parents should be able to spend an ample amount of time with their children, especially in their developing age and fill the gaps, which remain unfilled by the school. Increasing competition, growing economy and work pressure, however, make it very difficult for the parents to do so. The problem aggravates for the children that come from homes that suffer from socio-economic disadvantage and parents lack higher education.

Overcrowded Classrooms

Bigger classrooms suffer from divided attention of the teachers and mentors. 'A study by the National Center for Education Statistics found that 14 percent of U.S. schools exceed capacity '. This makes it difficult for teachers to teach effectively and students to get private attention. Increase in population aggravates the problem even further.

No Acknowledgment of Diversity: Age, Gender and Learning Styles

Children in the classrooms are looked upon as a bunch rather than as individuals. We all are unique individuals with our own personalities and traits. This individuality needs to be acknowledged, respected and thrived in the schools for bringing out the best in each child, rather than forcing him/her to act in a certain way. Each child has a unique talent or an interest. When this talent is not recognized, it gets lost away throughout the journey of the school. Due to this, some children lose interest in learning, as the entire process gets stressful and boring, while some drop out, and others just graduate for the sake of completing high school. Also, the diversity that comes with our gender, culture, age and preferred learning style should be recognized and harvested.

Passive and Monotonous Learning Environment

Classrooms are the areas where most learning takes place in schools. It is important for classrooms to have a flexible, engaging, playful and stimulating environment where children thrive, grow and enjoy rather than a stressful and boring environment where learning is very passive. Kindergarten classrooms are especially cluttered with innumerable things that add to the visual noise and take up a lot of space that can be utilized for moving around. They have traditional old furniture comprising of tables and chairs, that are non-flexible and do not contribute to engaged learning. The environment reflects the idea that learning is confined to the walls of classrooms rather than promoting the notion that learning can take place anywhere.

Lack of Technology

With technological advancements soaring sky high, it makes much more sense to expose the young minds to digital learning. If not implemented properly, digital learning can lead to several downfalls, such as education turning more into passive entertainment and too much reliability on technology for learning. Use of technology in classrooms should depend on the learning interests of children and their comfort level with technology.

Lack of Teacher Education Innovation

Educational reform cannot be one-sided only. If the environments, tools and curriculum need a change, so do the teachers. Teachers should be better educated about functioning of the modern world and dealing with large number of students. They should be equipped with modern education tools and should constantly communicate with the parents about the progress oft he child and provide necessary attention in case the progress is slow.

Lack of Post-School Preparation

'The National Assessment of Educational Progress (NAEP), the largest standardized test administered in the United States, reports that fewer than 40 percent of graduating seniors have mastered reading and math and are poorly equipped for college and real-world life.' While 80% of high school students graduate from school, half of them fail to qualify for college or higher studies, as they are not proficient at math and reading. Schools lack strictness when it comes to promoting children to higher grades when they are not even able to complete the coursework for the current grade. These students either don't make it to higher studies or drop out of colleges soon.

These factors lead to one in five dropout rates in High Schools and an even higher dropout rate from colleges/universities or unsuccessful qualification into them. While Education is an instrumental tool in developing an individual and a nation, it faces several difficulties in making it a successful reality.
With all these issues facing the Education System, this thesis was carried out with an attempt to conduct an in - depth research into the causes of the problems, develop potential solutions for changing the conventional way of learning in the classrooms and test the solutions in the real world.

Due to the time limitation, the scope of the thesis was narrowed down from the broad term 'Education' to a specific range of Education, which is the **Kindergarten Level Education**. Kindergarten was chosen as the target area of problem because the main aim was to research and develop a solution that improves the current system at the root level. Research shows that early education, especially the years from Kindergarten to grade three are the most important years in the lives of students, contrary to the popular belief a lot of parents have about Kindergarten being mostly about socializing and not a critical part of child education.

According to research, children who have been exposed to an effective early age education have 'improved social skills, less or no need for special education instruction during subsequent school years, better grades, and enhanced attention spans.' These children 'usually graduate from high school, attend college, have fewer behavioral problems, and do not become involved with crime in their adolescent and young adult years.'

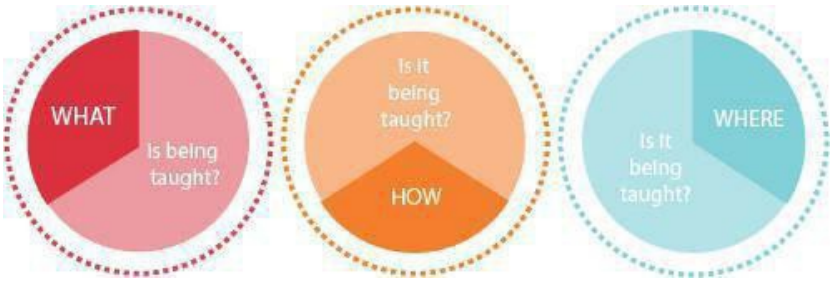
2. Research of Kindergarten Education System

The topic of Education provides a huge array of research. The **strategy** adopted for conducting this research effectively in the given time frame was to break down the research in three main topics:

What is taught in Kindergarten classrooms?

How is education in Kindergarten classrooms imparted?

Where and in what environments does Kindergarten learning take place?



2.1 What is being taught in Kindergarten Classrooms?

Majority of the states of the United States (42 out of 50) have adopted the **Common Core Curriculum.**

What are Common Core Standards?[3]
'The Common Core is a set of high-quality academic standards in mathematics and English language arts/literacy (ELA). These learning goals outline what a student should know and be able to do at the end of each grade. The standards were created to ensure that all students graduate from high school with the skills and knowledge necessary to succeed in college, career, and life, regardless of where they live. Forty-two states, the District of Columbia, four territories, and the Department of Defense Education Activity (DoDEA) have voluntarily adopted and are moving forward with the Common Core.'

Common Core standards evolved as a need for standardizing what students should learn at each grade in each state across the country. 'The standards define the knowledge and skills students should gain throughout their K-12 education to graduate high school and be prepared to succeed in entry-level careers, introductory academic college courses, and workforce training programs.'

Common Core standards for Kindergarten: [4]

Most of the learning in Kindergarten classrooms is focused on two main areas:

1. Learning about whole numbers and representing them using objects.
2. Learning about basic shapes andspaces.

Common Core Standards for the Kindergarten consist of learning about the following:

1. Counting and Cardinality
2. Operations & Algebraic Thinking
3. Number and Operations in Base Ten
4. Measurements & Data
5. Geometry

Pros and Cons of Common Core Standards: [5]

Pros:

1. The common core standards are benchmarked against the educational standards in other countries. This is because the ranking of the United States has dropped down considerably compared to other countries over the last few years, and the Common Core is expected to bring the rankings up.
2. Common Core standards have allowed standardizing the comparison in the test scores between different states. Unlike the older times, when each state had its standards and assessment criterion which made comparing the test scores and progress in each state difficult.

Cons:

1. The Common Core standards are very broad and vague. Some schools and teachers have figured out ways of making them more teacher and student friendly.
2. Common Core standards do not provide a special or modified version of tests for children with special needs.

---

[3] 'Common Core State Standards Initiative', http://www.corestandards.org/

[4] 'Common Core State Standards Initiative', http://www.corestandards.org/

[5] Derrick Meador, 'What are some Pros and Cons of the Common Core State Standards? ', updated on May 31, 2017 https://www.thoughtco.com/common-core-state-standards-3194603

While the Common Core Standards cover the basic skills and knowledge that children are expected to learn and practice at an early age, the standards should also accommodate for real world challenges, which are less based on facts and figures in the textbooks and are more about problem solving and facing challenges in practical situations. Problem solving, decision making and creative thinking are some of the skills that can be imparted at a younger age to prepare them better for the future years to come.

2.2 How is Education being imparted in Kindergarten Classrooms?

There are several different schooling methods Kindergarten classrooms adopt, some of which are:

Montessori[6]

Developed by Maria Montessori in early 1900s. Children learn at their own pace and develop independence, leadership skills, divergent thinking, creativity and social skills. Play is a child's work and classrooms consist of mixed age groups. Teachers act as **guides** and move around. They watch children, what they gravitate to, what they avoid and develop strategies accordingly. Children working on different topics can sit next to each other and help one another. There is no fixed curriculum, tests, homework or grades. **'Seeing what you learn, and learn what you see'** is the mantra followed as children learn through experiences, surroundings, curiosity and explorations. Children are active and use a lot of hand and body movements to learn. Montessori toys are used which are called **Manipulatives** and are self-corrective; the feedback tells the child if they are right or wrong. This way, they figure out their own ways of solving problems.

Waldorf[7]

The goal of this system is to develop the child **emotionally** and **physically** as well as **intellectually**. It is good for students who thrive on predictable rhythm. Waldorf preschools strive to nurture a child's spirit, soul, and body and to focus on the child's interests. Every teacher must be Waldorf certified and remain with the same group of students for up to 8 years forming a trusting relationship. The atmosphere is home-like, with all-natural furnishings and playthings.

Reggio Emilia[8]

Reggio Emilia schools are based on the highly successful preschools developed by the townspeople of **Reggio Emilia**, Italy during the 1940s. The curriculum consists of projects that reflect the **interests** of the students. Teachers observe the spontaneous curiosity of their students. Children's play and projects are documented in photographs and records of their own words, which allow teachers and parents to follow each student's progress. In a project-based curriculum, lessons are based on the interest of the students, and children are expected to learn through mistakes rather than correction. **Environment** is used as the third teacher in this system, which is homelike to help make children feel comfortable and learn practical life issues.

---

[6] Concordia University, 'Is the Montessori Curriculum Effective?', updated on January 7, 2016 http://education.cu-portland.edu/blog/curriculum-instruction/is-the-montessori-curriculum-model-effective/

[7] Laura Lewis Brown, 'Comparing Preschool Philosophies: Montessori, Waldorf and More' http://www.pbs.org/parents/education/going-to-school/choosing/comparing-preschool-philosophies-montessori-waldorf-and-more/

[8] Great Schools Staff, 'Preschool Philosophies, A to Z', published on May 15, 2015 https://www.greatschools.org/gk/articles/preschool-philosophies/

High Scope

Dr. David Weikart, a Michigan educator, started high Scope in 1970. It uses the approach called **Active Participatory Learning**. Children learn actively by having hands-on experiences with their surroundings, through supportive adult interactions. Learning is supported through consistent daily routines and **well-organized** classrooms. High Scope takes an academic slant with planned experiences in the basic subjects of math, reading, and science. It is based on past and current child development. Children and adults learn collaboratively. High Scope advocates learning experiences such as arranging things in order, counting and telling time as well as more creative and linguistic activities such as singing and dictating stories. Some programs involve computers in the learning process. High Scope was originally developed for at-risk urban children. There are specific periods in each day for small group times, large group times, and for children to play independently. **"Plan-do-review"** is another major component of the High Scope framework. Children are encouraged to:

1) Plan the area, materials, and methods they are going to work with
2) Do, carry out their plan
3) Review, articulate with the classroom community what they did during work time.

The review time helps children bring closure to their work and link their actual work to their plan. **Cleanup time** is a natural part of plan-do-review.

Bank Street

Bank Street preschools are based on the early childhood program run by the Bank Street College of Education in New York City, which was founded by Lucy Sprague Mitchell in 1916. Lessons focus on the social sciences (such as history, geography and anthropology). Artistic and scientific lessons are included within cultural lessons resulting in an integrated curriculum. Students set the learning pace, and the teacher serves as a **guide**. Comparable to play-based learning, the Bank Street approach teaches lessons through **hands-on activities**, such as building blocks, puzzles, clay, and dramatic play. Children are "active learners, explorers, experimenters and artists" and benefit from a **diverse curriculum**. Children may work alone or in groups. Classroom toys are basic, encouraging children to exercise imagination during play.

Co-operative

Parents who want a big role in their child's preschool education may want to consider a Co-operative preschool, which can follow any preschool philosophy or a combination. Its distinguishing characteristic is that parents take on significant roles at the school and are actively involved with their little one's education working closely with the classroom teachers. This hands-on approach allows parents and children to learn together in a nurturing environment. Parents are involved in the business operation of the school by serving on the school's board of directors.

Religious

Many churches and religious schools offer preschool programs. They may follow any preschool philosophy in determining curriculum and they may incorporate varying degrees of religious content and/or training.

2.3 Where/What Environment does Kindergarten Education take place in?

The first eight years of formal schooling are referred to as Primary Education in the United States. The first year of this schooling starts with the Kindergarten. These schools can be public or private. The way the children are taught in these classrooms is based on one of the philosophies mentioned above or could be a mix of different schooling philosophies.

According to a study, **'school's physical design can improve or worsen children's academic performance by as much as 25 percent in early years.'**[9] The **physical environment** of the school and the classroom play a crucial role in affecting the learning of the children and their overall development.

Indoor Air Quality (IAQ), Temperature and Ventilation:
'Earthman (2004) rates temperature, heating and air quality as the most important individual elements for students' achievement.' While these factors not only determine the health of the students and teachers but also affect the learning curve as poor air quality results in higher absenteeism. Some type of 'fleecy' furnishing and furniture material should be avoided that cause dust, allergens and irritants in the air.

Noise: [10]
Exposure to chronic noise results in hampering of cognitive functioning and reduced concentration in reading. Noise and Acoustics are fundamental to school's design. Also, when teachers pause while teaching due to external noise coming from surroundings, it could lead to a loss in teaching time as high as 11%. There are some noises that can interfere with the encoding stage of the memory. There has been other research on the problem of inadequate acoustics, and some ways of solving them such as increased carpeting and sound amplification systems to dampen reverberation.

Lighting: [11]
Different kinds of lighting that can be used in the classrooms can be artificial lighting or natural lighting. While some researchers say that natural lighting has the most positive effect as it produces biological effects on human body, depending solely on daylight in the classroom is not feasible and practical.

---

[9] Huffpost, Education, 'School Design, Classroom Layout Can Heavily Affect Student Grades, Learning: Study', updated on January 23, 2014 http://www.huffingtonpost.com/2013/01/03/school-design-student-grades_n_2404289.html

[10] Ministry of Education, 'The Impact of Physical Design on Student Outcomes ', November 2016 https://education.govt.nz/assets/Documents/Primary-Secondary/Property/School-property-design/Flexible-learning-spaces/FLS-The-impact-of-physical-design-on-student-outcomes.pdf

[11] The Center for Learning and Teaching, School of Education, Communication and Language Science, University of Newcastle, 'The Impact of School Environments: A Literature Review', http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=195B2B0D479CAAC7057E6BBE1EAA9DB8?doi=10.1.1 .231.7213&rep=rep1&type=pdf

There should also be some artificial lighting facility that automatically responds to the level of artificial lighting and dims or increases as required. Inappropriate lighting can lead to headaches, eyestrain and fatigue. To avoid these, 'Karpen (1993) suggests the use of full spectrum polarized lighting as it is glare-free and flicker-free. As there is an increased use of computers in schools, the idea of creating glare free lighting is important (Barnitt, 2003).' Also, Knez and Kers (2000) studied the effects of different kinds of lighting in relation to gender and age and found that females are more perceptive to lighting than men.

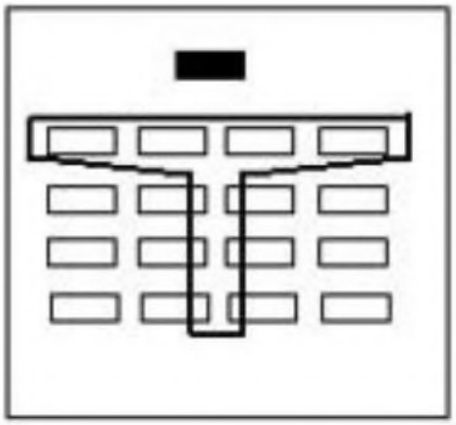
Color:

Colors not only attract one's attention but can also affect one's mental clarity, mood and energy levels. Every color has an impact on a person, that triggers certain emotions in the mind. While younger kids get attracted to bright colors and patterns, older children prefer softer tones. Color of the surroundings and height of the ceiling are known to affect the behavior of the children in the classroom. Cool colors are associated with concentration. Eye fatigue is often a common complaint in the classrooms. Engelbrecht, Pile and Brubaker suggest that the end wall of the classrooms behind the teacher should be a different color from the other walls, which should be a neutral color.

Furniture and Equipment:

Ergonomically designed furniture makes the classroom and learning experience more comfortable and pleasurable. Children are less susceptible to back pain and their productivity and concentration increases. Studies over the years have shown that back pain exists among school going children.

The traditional row and column arrangement have been debatable over decades and are considered as hampering learning. In such an arrangement, an action zone, which is in the form of 'T shape' or a Triangle shape forms where the involvement is high, compared to the seats out of this zone. More than the students, this zone influences the attentiveness of the teacher. Researchers recommend a 'horseshoe' formation of rows and columns, where students can see each other. This has been seen to increase activity among students.



[12]

[12]The Center for Learning and Teaching, School of Education, Communication and Language Science, University of Newcastle, 'The Impact of School Environments: A Literature Review', page 26 figure 11 http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=195B2B0D479CAAC7057E6BBE1EAA9DB8?doi=10.1.1.231.7213&rep=rep1&type=pdf

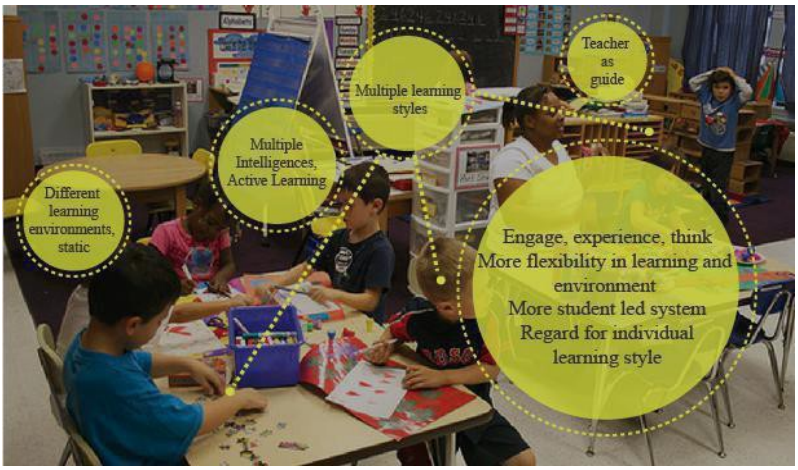
Display and Storage:
These are important yet the most underrated factors while keeping physical design elements of a classroom in mind. Having a good storage facility increases the efficiency of teaching and learning time within the classroom. Displaying the work of children, be it by allocating a small space within the classroom or making their work a part of the school building, gives them a sense of ownership of their work and makes them more trusting and confident towards their school.

2.4 Evolution of Kindergarten Classrooms

19th Century Kindergarten Classrooms:

Kindergarten classrooms showed typical hierarchy where teachers had full control over the children and their activities. The teacher stood mostly in the front of the classroom and seldom moved around. The children sat in rows and columns, their chairs and desks faced the teacher and the blackboard. The number of children in each classroom was usually large hence the classrooms were crowded and there was less free space to move around. The teachers gave the instructions and the children listened, read, memorized and recited. It was a very **non-flexible**, **passive**, t**eacher led system** where there was **no** regard for **individual learning style**.

20th Century Kindergarten Classrooms:



Classrooms inthis era showed a lot more flexibility in terms of environment and teaching styles. Instead of classrooms being uniformly designed, different zones popped up, which were determined

by the furniture. Hence different types of furniture were being used for different activities, though they were all static. Students were given freedom for choosing the tool for learning; there was more **accommodation** of **learning styles.** Teachers acted as **guides**, who did not dictate but became more engaged with the children. Students started doing a lot of activities. Hence, it became a very **dynamic**, **active** and **engaging** learning area where there was more **flexibility** in terms of movement and **availability** of **different learning tools.** It shifted to a **student led system**.

21st Century Kindergarten Classrooms:

The Kindergarten classrooms in this era show increased activity, **flexibilit**y and accommodation of learning styles. The furniture and storage spaces continue to remain static and occupy a lot of space within the classrooms adding to visual noise. There are different **activity zones** defined by the furniture kept in each zone. An important addition is the use of **Technology** in the classrooms in the form of computers, ipads and video games. Teachers continue to act as guides. Classrooms overall are very **flexible**, **active**, provide **multiple learning tools** and the use of **Technology**.

Studies have shown that the younger generation of the 21st century is better than the younger generation of the 19th century and there is a considerable increase in the IQ levels. The main reasons behind this phenomenon are better schooling and educational systems with more nourishing and stimulating environments. This clearly indicates that the educational systems and schools have evolved and come a long way for the better. However, there is still much room for improvement and enhancement due to a rapidly changing society. The younger generations need to be prepared for the times to come and the whole process needs to become more personalized to every individual, something that hasn't been done before.

2.5 Margaret's House

Margaret's House is a childcare center located on campus at the Rochester Institute of Technology. It provides full day care and education for children, 8 weeks old to Kindergarten, and provides after school care for children from first to third grade. **Ms. Susan Northrup** is a Kindergarten teacher at Margaret's House and one of the mentors for this thesis. The thesis was undertaken under her supervision who provided valuable insights into the Kindergarten education, curriculum, child behavior and space design. With her support, it was possible to do weekly observations, conduct interviews, record data in the form of pictures or written scripts, study the classroom environment and conduct user testing of the final prototype.

[13]

[14]

[13] Margaret's House at the Rochester Institute of Technology campus

[14] Kindergarten classroom at Margaret's House

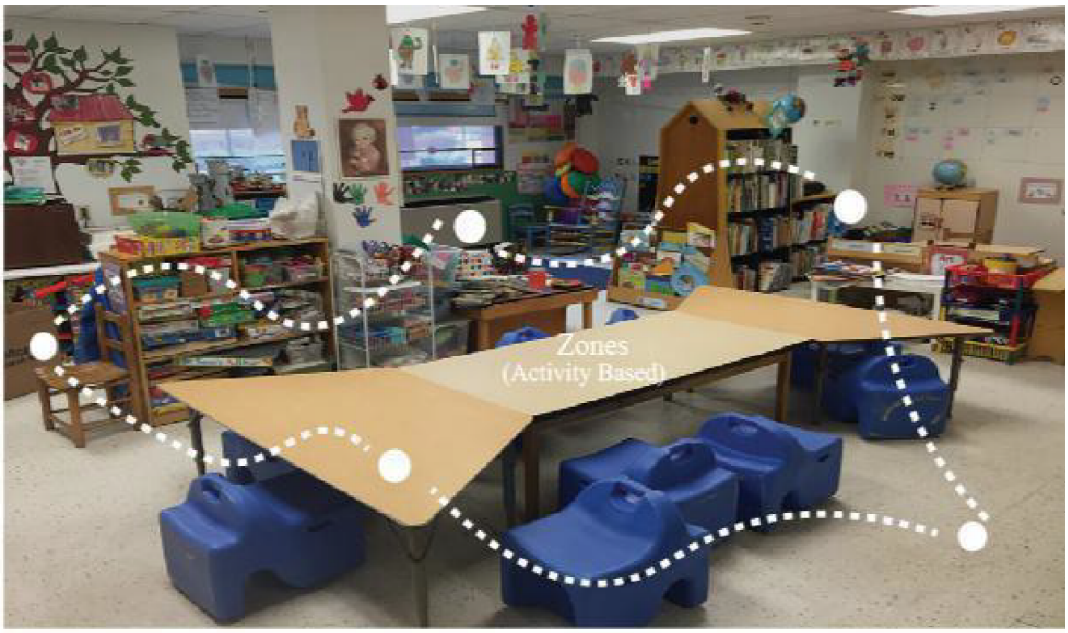
[15]

2.6 User Study and Interviews

Ms. Susan Northrup has around 12-15 children in her Kindergarten classroom each year. Each child is between the age of 4-5 years. The children are involved in several activities throughout the day and their learning is very hands-on. The activities differ on each day of the week, but on a general basis the children are involved in the following activities:

8.30 AM: Morning circle time
9.45 AM: Lesson activity planned for the day
10.15 AM: Arts and crafts
12.00 PM: Lesson activity planned for the day
1.00 PM: Outdoor playground time
2.30 PM: Story telling time
2.45 PM: Nap time
3.45 PM: Free play time

The kindergarten classroom at Margaret's House looks like the picture shown below.



[15] Ms. Susan Northrup, Kindergarten teacher at Margaret's House and Thesis Mentor

It is quite similar to classrooms in the public schools in the United States. Kindergarten classrooms in the private schools are also similar but some might be bigger in size. Some of the common observations made at the Margaret's House classroom were:

1. Visual noise and clutter
2. Less space to move around
3. Different kinds of furniture
4. Different activity zones. (The kind of furniture kept in the zone determines the activity that takes place in that zone)
5. Kids spend a lot of time on the rug
6. Storage is inside the classroom
7. Adequate sunlight
8. Teacher moves around the classroom, has her own desk in a corner
9. Children use Vidget chairs instead of conventional stools, which help them move
10. Children are assigned a 'Play Time' exclusively within their schedule when they either go out and play in the playground or play indoors with each other using toys and blocks

Most of the children love to spend time on the rug. It is kept near the toys and blocks, which they like to play with individually or in groups. They usually build something using the different blocks they have and then engage in role-play where they make up different stories around what they have built and assign it a character. On asking them what is their favorite part of the day while at school, most of the kids replied instantly 'when we play!'. On asking Ms. Susan about what the kids enjoy doing the most during the day, her answer was 'anything where they can move!'

2.7 Takeaways from the Margaret's House Kindergarten Classroom

These observations and interviews led to the second important part of the research, which was conducted on the following topics:

1. The importance of Flexibility and Movement in the classroom
2. Accommodation of Diversity in the classroom
3. The importance of Play in Education

1. The Importance of Flexibility and Movement in a Classroom[16]

Most of the schools order furniture in mass to save money instead of selecting furniture that is built to cater to a specific activity/learning style or learning objective. Classrooms need to be set up to promote movement, personalization and collaboration. When a classroom achieves these objectives, it means it provides for flexible learning.

Flexible learning has several benefits on the health of the students. It burns calories, improves metabolism, uses excess energy, increases blood flow to the brain, increases motivation and engagement and improves posture. Tactile stimulation and physical movement can increase the plasticity of the brain and stimulate it. A student who sits in the upright posture learns better than the one who slouches. Students sitting in incorrect postures do not get sufficient oxygen and blood flow.

---

[16] Robyn Howton, 'Turn your classroom into a personalized learning environment', published on August 16, 2017 https://www.iste.org/explore/articleDetail?articleid=416

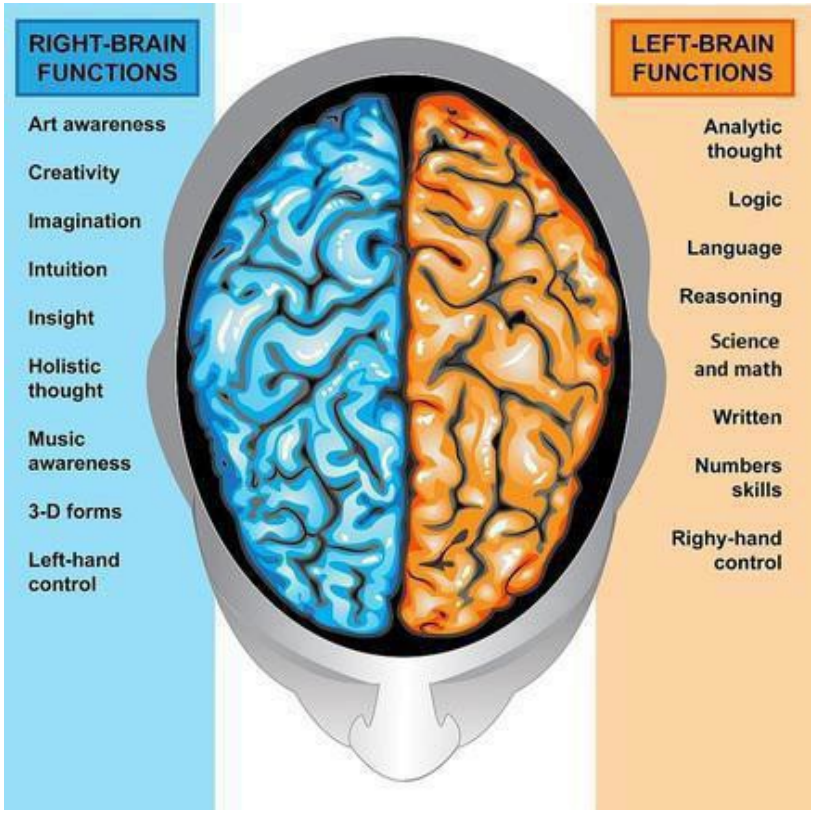
Laura Bradley, 'Collaboration on Wheels: 21st Century Classroom Furniture at Work', edutopia, published on March 9, 2014
https://www.edutopia.org/discussion/collaboration-wheels-21st-century-classroom-furniture-work

Real world collaboration means that when an individual is faced with a challenge, he has the ability to find the right people who can help him solve the challenge and go over to them for help, and when he wants to work alone, he has the facility to work alone. In this entire process, he should not be restricted by parameters of space, time, number of people around him or the equipment he is using. This phenomenon should be encouraged in classrooms as it helps in learning better and teaches them to work in teams. Classrooms can be provided with collaborative furniture which could be anything from chairs with wheels which help different students come together or move away swiftly or desks that can be arranged in a manner that makes collaborative working easier.

Personalized learning refers to tailoring the instructions, the style of teaching and assessing the progress of every individual according to their unique needs and preferences. Recognizing the strengths and weaknesses of students, their learning style, letting them make choices, selecting the best way to give instructions and timely assessments while teaching are some of the ways of personalizing education.

2. Accommodation of Diversity in the Classroom

Brain Based Learning:



[17]

The brain is designed for **survival**, not instruction. The natural structure and design of the brain helps it in functioning in such a manner that it meets its ultimate destiny-survival, and in the process, it learns new things and becomes 'smarter'. Like fingerprints, each brain is different than that of another. Hence, every person learns differently. Group learning, therefore, has little effect on making the brain smarter.

---

[17] 'The Brain Made Simple', http://brainmadesimple.com/left-and-right-hemispheres.html

'[A]ny group instruction that has been tightly, logically planned will have been wrongly planned for most of the group, and will inevitably inhibit, prevent or distort learning'

Each brain has a different timetable for development, which means that for some brains, the normal age to start reading is two, while for others, it could be seven. The **left hemisphere** of the brain processes "parts" (sequentially) while the **right hemisphere** of the brain processes "wholes" (randomly). Today, this theory seems to be outdated, as people show creativity using logic and rules while making something creative. The left-brain is becoming creative and the right brain is becoming logical. Hence, there needs to be a shift from 'left brain v/s right brain' teaching to **'whole brain'** learning also called **'lateral thinki**ng'. [18]

Learners, Learning Styles and Multiple Intelligences:

[19]

Howard Earl Gardner (born July 11, 1943) is an American developmental psychologist and the John H. and Elisabeth A. Hobbs Professor of Cognition and Education at the Harvard Graduate School of Education at Harvard University. Howard Gardner has identified seven distinct intelligences. According to this theory, "we are all able to know the world through language, logical-mathematical analysis, spatial representation, musical thinking, the use of the body to solve problems or to make things, an understanding of other individuals, and an understanding of ourselves. Where individuals differ is in the strength of these intelligences.

---

[18] Eric Jensen, *The Learning Brain* (California: Turning Point Publishing, 1995), 3-4

[19] John N, 'The Theory of Multiple Intelligences and AI', published on December 25, 2016 https://edgylabs.com/multiple-intelligences-ai/

The different learning styles are:[20]

1. **Linguistic Intelligence:** Deals with the ability to learn new languages and use it to express oneself effectively and accomplish goals. Writers, poets, speakers and lawyers are people with high linguistic intelligence according to Howard Gardner.
2. **Logical-mathematical Intelligence:** Deals with the ability to look at a problem logically, investigate solutions scientifically, carry out mathematical operations and detect patterns.
3. **Musical Intelligence:** Deals with the ability to recognize and compose musical notes, pitches, rhythms and appreciate musical patterns.
4. **Bodily-kinesthetic Intelligence:** Deals with the ability of using one's body or parts of the body to solve problems and learn new skills.
5. **Spatial Intelligence:** Deals with the ability of using the space, surroundings, patterns of space around to learn and solve problems.
6. **Interpersonal Intelligence:** Deals with the ability to understand emotions, motivation and intentions of other people.
7. **Intrapersonal Intelligence:** Deals with the ability to understand and analyze oneself, one's strengths, weaknesses, fears and motivations.

There are three types of learners:[21]

1. **Analytical: An Analytical learner prefers to sit on hard seats, have no distractions around and sit and concentrate for long durations.** The typical classroom setting works best for these learners.
2. **Global: A Global learner prefers soft seating, low lighting and skips from project to project or do several projects at once.**
3. **Integrated: The Integrated or Flexible learner can learn in a variety of different environments.**

Within these groups are four different types of groups:

Auditory Learners: who learn best by listening
Visual Learners: who learn best by seeing and reading
Kinesthetic Learners: who learn best by using whole body, example: by educational field trips
Tactile Learners: who learn best by touching and making

Hence, while the traditional school setting might work the best for Analytical learners, it might be uncomfortable and boring for Global learners. Mostly, students with an IQ over 145 are thought to be Global learners and for them school might become a source of misery and boredom.

It is easy to identify individual student learning styles by means of a 104-question learning style inventory devised by the St John's University in New York City.

Gender:

Accommodating gender diversity in the classrooms becomes a problem when the teacher unintentionally creates a learning environment, which favors one gender more than the other. Two areas where gender differences become prevalent are **Science** and **Technology**, which arise due to differences in culture and upbringing. In the society, the male behavior is often expected as aggressive, active, and competitive and it is considered 'normal' for boys to get into trouble. On the other hand, for girls, the normal female behavior is considered to be calm, shy, supportive and collaborative. Boys are often encouraged to pursue fields like science and engineering whereas girls are motivated to pursue fields like fashion, interior design, child development etc.

---

[20]Smith, Mark K. (2002, 2008) 'Howard Gardner and multiple intelligences', *the encyclopedia of informal education*, http://infed.org/mobi/howard-gardner-multiple-intelligences-and-education/

[21]Roger Callan, 'Education: Would you like to sit on the floor?', published on April 7, 1999 http://www.independent.co.uk/news/education/education-news/education-would-you-like-to-sit-on-the-floor-1085806.html

Research conducted by Honey et al (1991) suggests that ' males envision technology as a tool to gain power and control over the physical universe, while females envision technology as a means to improve communication and collaboration.' According to research (Margolis & Fisher, 2001), girls are as capable at technology as boys; however, the latter seem to receive more encouragement from parents and teachers.

Culture:

The population of the United States comprises of people from every corner of the World and various cultural and ethnic groups. Though a heterogeneous population has a huge role to play in the gross economic and cultural development of the nation, when it comes to educational environment, these differences can also hamper learning at times. Two aspects of culture that can be measured and evaluated in the classrooms are: **English Language Proficiency** and **Socioeconomic Status (SES)**. There are about two million non-English speaking students in the United States classrooms. Students coming from low socio-economic status usually do not have the same kind of exposure and experience with technology and computers compared to the ones coming from high SES. It can become difficult coping with this learning gap in the classrooms and help bring students at the same level.

Abilities:

Exceptional children are those that are unusually different in their skills and abilities. There can be three types of exceptional students:

Impaired: Physical impairments influence student's ability to interact with the learning environment and process information, such as Muscular Dystrophy and Spinal Cord Injury. Cognitive impairments impede student's ability to process information. Ex: Autism, Dyslexia, ADHD etc.

Disabled: A disabled student is limited in or cannot perform normal human activities, such as walking or reading. Some students might come across as disabled when they are actually disadvantaged. In a normal classroom environment where there is a lot of emphasis on reading and writing, a dyslexic child might be at disadvantage, however, he might benefit in an graphic learning environment.

Gifted/Talented: Students who perform extra-ordinary abilities in academics and co-curricular far beyond the standard range of abilities among other people are gifted/talented students.

Technology can prove to be a boon when it comes to coping with the disabilities or disadvantages and reducing the learning gap between various students. The various types of technologies that can be used are:

1. **Adaptive/Assistive Technology:** assist students with a task they cannot accomplish otherwise. Ex: spectacles.
2. **Remedial Technologies:** teach or remediate. Ex: software that teaches spelling, mathematics and reading.
3. **Compensatory Technologies:** helps students perform an academic task efficiently and effectively. Ex: Calculators and Spell Check Software.

2.8. The Importance of Play in Education

'Play is a spontaneous, voluntary, pleasurable and flexible activity involving a combination of body, object, symbol use and relationships. In contrast to games, play behavior is more disorganized, and is typically done for its own sake (i.e. the process is more important than any goals or endpoints).'

Play is:

- Pleasurable and enjoyable
- Intrinsically motivated
- Process oriented
- Freely chosen
- Actively engaged
- Non-literal

Children are naturally driven to participate in play, so much so that they can do it in the absence of real toys, parental encouragement and even in the middle of stressful situations.
Research supports the numerous benefits play has on the overall development of a child that teach children necessary skills to ensure future learning and success from Kindergarten to workplace.

- **Cognitive Skills:** Children develop and practice cognitive skills such as problem solving, creative thinking, language and self-regulation.
- **Social-Emotional Skills:** Children learn skills such as empathy, interaction with others, negotiations and compromise. They also learn about dealing with emotions such as fear, anger and frustration.
- **Motor Skills:** Running, jumping, chasing, rolling, drawing, building blocks etc. develop the fine and gross motor skills of children.

Play also teaches the **"6C's"** which are Collaboration, Communication, Content, Critical Thinking, Creative Innovation and Confidence.

Despite of all these advantages of Play, overall time spent by children playing is decreasing compared to the children two decades back. Children should be encouraged to participate in different kinds of play at schools and homes. Play should be embedded in learning rather than treating it like a different phenomenon.

The various kinds of Play are: [22]

1. **Social Play:**

Social play is the kind of play that takes place when there is interaction between different children or between children and adults.

- **Social play with adults** is structured and sophisticated. Parents, especially mothers, are usually the first play partners of children. Even as children grow up, parents should be involved by comments, prompts or guidance.
- **Social play with peers** can be great for developing cognitive and social interaction skills. Children exert more control over the situation and there tends to be an equal distribution of power and authority when there's play between peers compared to play with adults.

2. **Object Play:**

Once children have developed enough motor skills, they start exploring the world around them by touching objects and make them their toys.
"Throughout childhood, object play remains a large part of the daily routine, occupying approximately 10-15% of children's waking hours by conservative estimation (Smith & Connolly, 1980)."

Different types of Object Play are:

- **Exploratory Play:** It starts at an early age (about five months) when children start becoming curious about the objects around them. As they grow older, by the second year, they start combining different objects (ex: build a train from blocks) or assign a meaning or identity to objects (ex: a block could be a cake).

- **Object Play:** Playing with objects helps children ask questions, reason, think practically and try to explore answers to questions such as 'how does this object operate?' or 'what does it do?'. In the process, they solve problems and develop creativity by finding new functions of the objects, new ways of using them or making new objects from the ones they already have. By playing with objects such as blocks, sand, balls, crayons etc., children also learn the basic concepts of mathematics such as counting, measuring, classification, parts compared to wholes etc. They observe, experiment and fail. This starts laying the foundation of STEM courses that they would be studying in later years.

Convergent and Divergent Thinking:

Convergent thinking is the type of thinking where you arrive at one correct answer to a question or a challenge and there is no room for creative thinking. Multiple answer questions or school tests usually require convergent thinking to excel.
Divergent thinking has no right answer. It requires thinking creatively and taking into consideration the range of all possible solutions. Play encourages divergent thinking because during play children are constantly coming up with new ideas and are being creative with different situations. While convergent toys and play helps in developing convergent thinking skills, the advantages of divergent thinking are

---

[22] Lindsey Gudritz, '6 Types of Play Important to Your Child's Development', published on June 20, 2016 http://www.healthline.com/health/parenting/types -of-play#1

Amanda Rock, '10 Types of Play Important to Your Child's Development', updated on July 21, 2017 https://www.verywell.com/types-of-play-2764587

broader. Children who play with divergent toys perform better at both divergent and convergent problem- solving tasks. These kids are more creative, innovative and flexible when it comes to facing challenges and solving problems. A jigsaw puzzle set which has one solution is a convergent toy while a set of multi- options **blocks** is a **divergent to**y as the possibilities with the blocks are endless.

3. Pretend Play:

Pretending refers to creating alternate realities to the real world. Children can pretend to be anything or anyone around them and create narratives around it. Pretend play could be **symbolic** (when children assign an identity or a meaning to a specific object) or it could be **socio-dramatic** (when children pretend to be different characters and involve other people as well).

Within the area of play, Pretend Play has the most obvious and maximum number of benefits. It has been known to improve cognitive, social and emotional development. 'Vygotsky was perhaps most resolute in his belief that pretend play is a "leading factor in development", that develops a range of skills and culturally valued competencies (Ber, Mann, & Ogan, 2006).'

Some of the benefits of pretend play are:

1. Cognitive Benefits

Creativity
Language and Literacy
Executive Function

2. Social and Emotional Benefits

Navigating Interpersonal Interactions
Socialization
Social Understanding
Dealing with Emotions

4. Physical Play:

Physical activities such as running, jumping, rolling, chasing, climbing and throwing are all part of the physical play. Despite the numerous advantages of physical play on cognitive and motor skills development, it is given the least importance in schools and homes. Recess time is decreasing in schools and children are playing outside a lot lesser than they did decades ago.

Approximately, one-third of American children between the age of 2-19 years are overweight or obese (American Heart Association, 2011). Introducing children to physical activity at an early age in life helps them maintain a healthy lifestyle throughout their life. Children between the age of 6-17 years should be playing for 60 minutes a day according to Centers for Disease Control and Prevention (2011). Gaining and strengthening muscle, aerobic endurance, growth stimulation of some organs, hand eye coordination etc. are some of the advantages of physical play.

5. Media Play:

Technology has become a huge part of our and children's lives. It has also started playing an important role in the classrooms. The games on media offer a wide variety of presentation of materials i.e. visual, auditory, spatial, tactile etc. and can highly benefit children with different learning styles. These games offer challenges, require quick decision-making, promote exploration, encourage experimentation, problem solving and even accepting failures. There is usually a debate going on with the use of technology in the classrooms. Technology should not be allowed to replace traditional forms of play, be it outdoors or with blocks and figures. People should look at technology as a learning aid rather than a threat. The entire world is advancing in technology and it's high time the classrooms start doing so as well.

2.9 Design Problems with Margaret's House Classroom

Based on the Research and Study of the Margaret's House classroom, some of the opportunity areas discovered as **design problems** were:

Space Issue:
The Kindergarten classroom at Margaret's House is **cluttered** with a lot of things from craft products to toys. The classroom is large but occupied with a lot of stuff, which increases the visual noise largely. Most things are not even used but are still stored in the classroom. There is a bathroom, sink and a huge window in the classroom. The things needed for activities are stored within the classroom and the students or the teacher take the things as needed and put them back when the work is done.

Furniture and Activity Zones:
The classroom provides different zones where students perform different activities. There is a huge workspace in the middle of the classroom, which is meant for group activities. Several tables are combined to make one large worktable and kids sit around it. The chair on which the students sit are the Vidget chairs designed by RIT Alumnus Ms. Sandra Turner which helps them move or 'fidget' on the spot so that they can concentrate better. In another corner, is a large rug on the floor that has toys kept in its periphery. Students mostly play on the rug in groups or alone. Next to the rug is a bookshelf and some desks where students can engage in private learning, like read a book in silence. Apart from this, they also spend some time each day outdoors playing in the playground. All these different set-ups provide for different kinds of learning. However, the different zones are stationary i.e. each zone is in one specific place only because of the large bulky furniture kept there. Hence, the furniture kept in one area determines the activity that is conducted there instead of providing students with a flexible space, where they can determine what and how they want to learn in the classroom. Also, for some activities, students move from one zone to another but because the classroom is highly congested due to the big unmovable furniture, the movement is not significant. The teacher mainly determines the activity that takes place in each zone too. Hence, the overall functioning and environment is **moderately student centric**.

Classroom Population and Activities:
Ms. Susan's kindergarten classroom comprises of 7 boys and 4 girls. She follows a mix of Montessori and High Scope style for teaching her class and customizes the curriculum and lesson plans according to the students and their learning styles. Students engage in play activities separately as well as embedded within the learning assignments. The students love to play with blocks and they have a lot of different types of blocks in the classrooms from gear blocks to construction blocks to Lego. They usually play in groups where they construct something using blocks and then form a story around it with characters. Apart from blocks, they play with figures, clay and crayons. While some form of **play** does exist, it is often **restricted** physically due to the available open space and surrounding furniture.

3. Project Statement

All these observations provide for opportunities where improvements can be made to make the overall environment more student-centric and accommodate more diversity in terms of learning in the classroom.

The Project Statement was described as follows:

'To develop a learning environment that is flexible i.e. it provides multiple learning spaces and positions, accommodates diversity i.e. it provides students with multiple learning tools and a choice in how they want to learn and is playful i.e. it does not look monotonous and boring but provides a stimulating playful environment.'

4. Benchmarking

4.1 Benchmarking of Learning Environment

This classroom has an extremely playful aesthetic. Its interiors have been designed taking a playground as inspiration. Being too literal in the concept, it loses the essence of being a classroom and is adding to the visual noise and clutter just like the conventional classrooms, with the type of clutter being different. Though the classroom may provide some initial excitement, it might become redundant in the future. Also, the slide is bulky and cannot be moved around. The furniture is conventional chairs and table. What is noteworthy about this classroom is that it is very spacious and provides for free movement and physical play, however most of the classrooms in the U.S. struggle with extra space and this kind of design would be seen as a luxury to have.

 [23]

[23] Kindergarten classroom at Trillium Creek Primary School, Oregon

This classroom seems to be very modern which displays the use of technology, accommodation of different learning styles and provision of different tools and furniture to support the various learning styles. While two students are reading books, one is working on a laptop and one is playing on a video game console. They are also sitting differently, one sits on a floor pad, one on a folding chair and two on rocking chairs. While the classroom style looks quite impressive, the furniture could be a little more flexible and provide for more sitting/standing options. Aesthetically speaking as well, the furniture could have a form more playful and exciting.

[24]

The most striking features of this classroom are its bright colors and the availability of large open spaces. It provides a very interesting look to the classroom and makes it inviting for the children. The furniture in the classroom, though shaped interestingly, still remains to be large and bulky and takes up a lot of space. It would be highly possible that the kids and teachers move around the furniture and it largely determines their activities and lesson plans. The classroom could use more flexible furniture that is easy to move around and accommodates different learning styles.


[25]

[24] Angie Schoeneck, 'Integrating Technology in Active Learning Spaces' http://ideas.demco.com/trends-topics/spaces/integrating-technology-active-learning-spaces- 2/

[25] Kindergarten classroom at Irving Elementary School, Missouri

This classroom shares some similar characteristics with the Margaret's House classroom in the sense that they both have a separate rug area and floor seating, the furniture for working is kept to one side next to the rug and the furniture has been arranged to support group activities. Though there are different learning zones, the activity in each zone is still being dictated by the space and the furniture in that zone. For example: the students are writing and sketching on desks as there is no provision for doing the same on the carpet area. The furniture also seems heavy and not easy to move by the students. The provision of large cushions is very interesting and could provide for a new type of seating pattern in groups or individually.

[26]

4.2 Benchmarking of Play Elements

For kids, anything can become a toy and a medium of play due to their imagination and curiosity. However, some special toys and games are designed in a manner that they help improve cognitive skills, mental and gross motor development, such as:

Puzzles: Playing with puzzles leads to development of physical skills, cognitive skills and emotional skills.
Physical Skills: Hand Eye Coordination, Gross Motor Skills and Fine Motor Skills.
Cognitive Skills: Understanding the surrounding world, shape recognition, memory improvment, problem solving.
Emotional Skills: Setting Goals, Patience, Reward.

Puppets and Dolls: Playing with dolls and puppets develops language skills in children. It makes them more aware of their surroundings and daily life tasks. The adult world can get a little overwhelming and unmanageable for kids, whereas dolls bring down the size of the world to a scale they are comfortable with. They develop emotional, nurturing and caring skills while playing with dolls. It also improves their imagination skills as they develop stories, scenarios and situation around the dolls and puppets.

[26] Kindergarten classroom at John Septimus Roe Anglican Community School, Australia

Cars, Trains and Planes: Playing with kinetic or static cars, trains and planes increases creativity and imagination, from figuring out different ways of putting tracks to coming up with new stories around them. It increases problem-solving skills by figuring out how to go about obstacles on train tracks or on the roads. It also improves fine motor skills and dexterity by creating big trains and planes from small parts to putting different pieces together to make a full set.

Blocks: Playing and building with blocks provides a valuable learning experience in the early childhood. It stimulates overall learning and develops all aspects of the brain such as emotional, social, physical, intellectual, language etc. Playing with blocks is a form of constructive play that sharpens creativity and imagination in children. Some of the advantages of playing with blocks include:

Developing Spatial Skills: Children in their early age start to get a sense of their surroundings and space around them with respect to the blocks they play with. They can manipulate the blocks, spaces and surrounding objects according to their play pattern. Moving the blocks in space, figuring out their directionality and how to place them, all lead to development of spatial understanding.

Math and Numerical Skills: Some of the mathematical concepts developed by playing with blocks include counting, comparing sizes, geometries, length and width, concepts of addition and subtraction and combination of different shapes.

Divergent Problem Solving: Problem solving is of two types: Convergent where the problem has only one solution and Divergent where the problem can be solved in more ways than one. Since playing with blocks can be done in several different ways and patterns, it leads to development of divergent problem solving skills. Divergent problem solving also strengthens creativity and imagination.

Co-operation and Social Skills: Children become more social as they play in groups with other children or adults. They cooperate with each other, share toys and might work in teams to build a structure. This also promotes language development. Cleaning up post play also makes them more responsible towards their belongings and surroundings.

Language Development: As children play in groups or under an adult's supervision, they develop language skills as they discuss what they are building or ask questions. Reading reference manuals and guides develops reading and comprehensions skills.

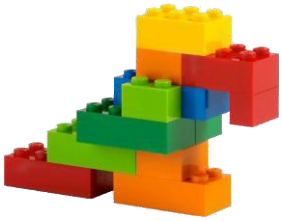
There are several different types of blocks available in the market for preschoolers and toddlers. Some of them are:

Unit Blocks: they are the most basic blocks made out of wood that last for years, they are called unit blocks as each block is a fraction of the standard unit, ex: quarter unit or half unit.

Large Hollow Blocks: they are usually large and hollow, they can be used to build life size structures

Foam Blocks: they are soft and light weight, they are usually colored and large in size

Building Bricks: they snap together and can form various different structures; some popular examples are Duplo and Lego.



Translucent Color Blocks: they come in a variety of colors and are very attractive to children, they can reflect back the colored light that falls on them and can be used to make patterns

5. Concept Formation

Targeting the Furniture

It was clear from the research and the studies conducted at the Margaret's house classroom that furniture played a pivotal role in the classroom. From being an integral part of the learning process to directing the classroom movement and activity, the furniture surfaced as a dominant element that could solve the project statement if re-imagined. Furniture of the classroom is also one of the products in the classroom that witnesses the highest level of interaction with users. Not only the type of furniture but also how it is arranged heavily affects the learning pattern and the teacher plans the activity according to the space available and the furniture present. Hence, it can be said that the furniture, to some extent, dictates the classroom learning and activity. Also, since the current furniture is not very exciting and rather conventional and boring, bringing about a change in the most dominant part of the classroom could change the entire aesthetic of the classroom which can be made more exciting and stimulating for the kids.

Integrating Furniture with Blocks

Playing blocks are simple play tools that have numerous benefits on a child's development in his early childhood. Also, they are one of the most engaging and fun play elements and hence a popular choice amongst children. Observations at Margaret's House support this statement where several types of blocks were observed and students spent a large part of their day playing with them in groups or individually. With so many advantages and research supporting their contribution in the development process of children, it was decided to take inspiration from this element of play and integrate blocks with furniture design. The aim of the thesis from this point onward was to design a system of furniture that is inspired by blocks in terms of function and/ or form and stays true to the **Project Statement**.

 [27]

Advantages of Integrating Furniture with Playing Blocks:

- Furniture that has a **playful form factor** would be exciting for kids and provide an overall playful aesthetic to the learning environment.
- Children would be developing their **motor and physical skills,** as they would be picking things, putting them together, changing orientation etc.
- Forming **flexible learning spaces** would be possible as different blocks can be easily moved and placed in different configurations to customize the space according to the user's needs.
- The large sized blocks would develop **spatial skills,** as the users would be manipulating the spaces around them, making sense of shapes and figuring out what goes where. When done in groups, it would also lead to development of social skills, teamwork and language development.
- As the size of the blocks increases, it would be easier to create **narratives** around them, assign personalities to blocks and engage in stronger **role-play**.

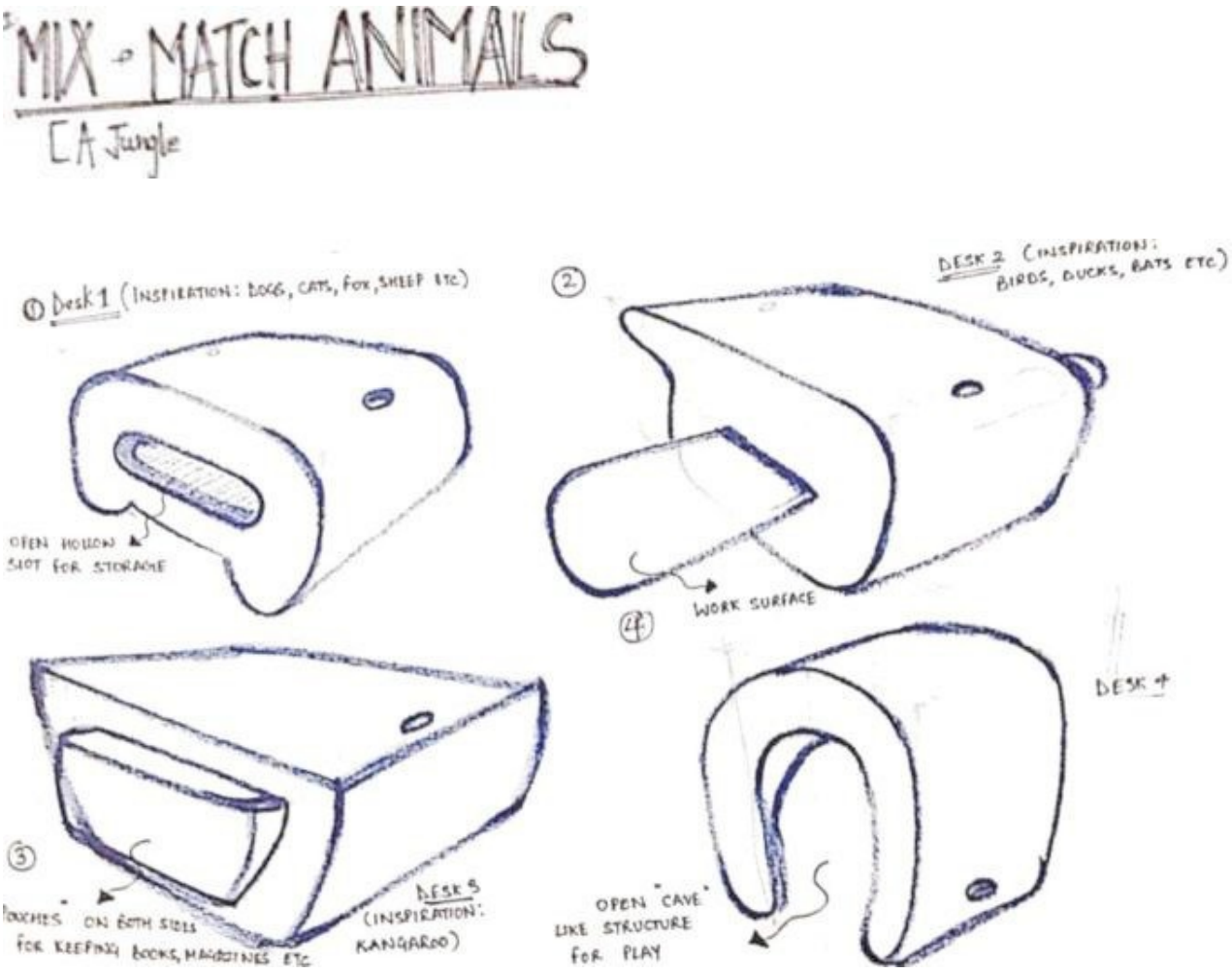
Concepts Exploration:

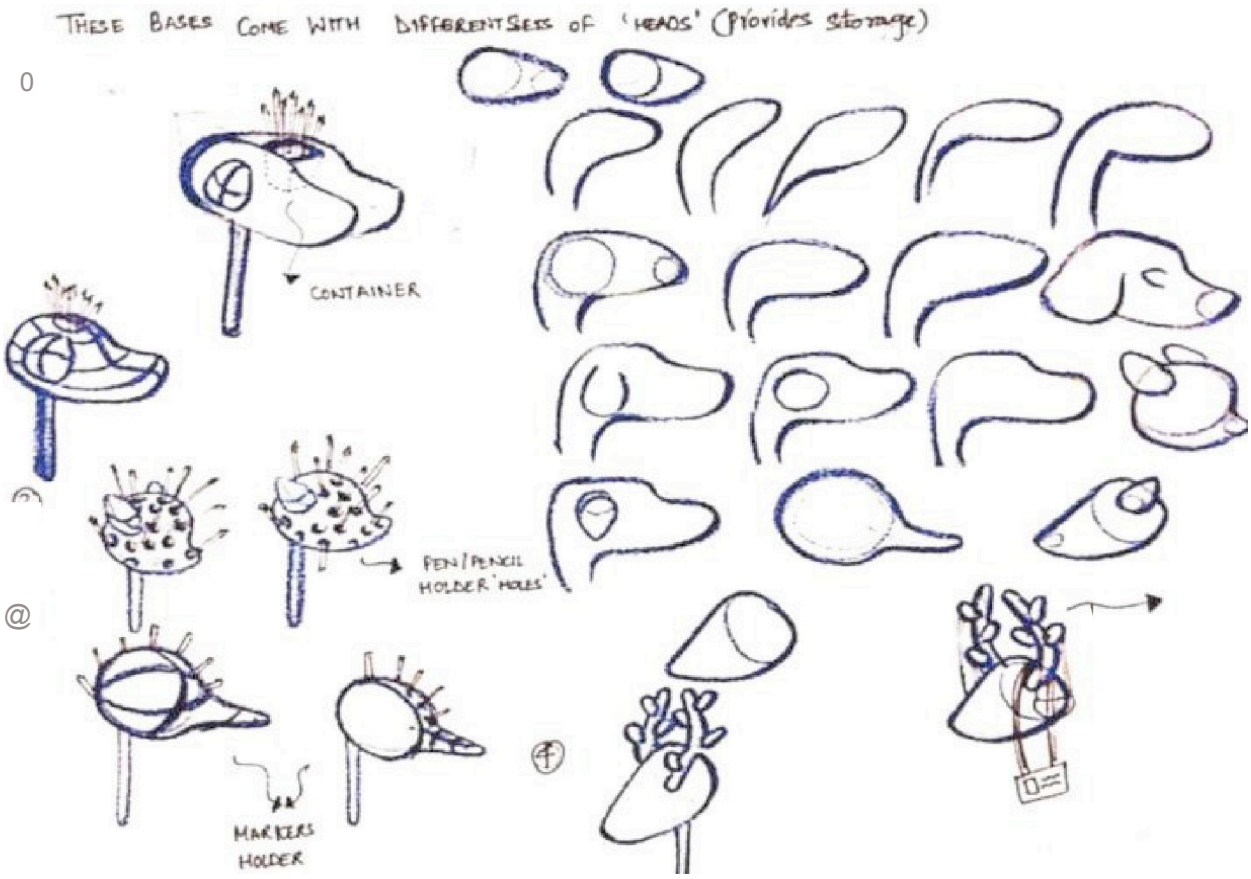
Concept 1: Furniture Blocks in the Form of Animals

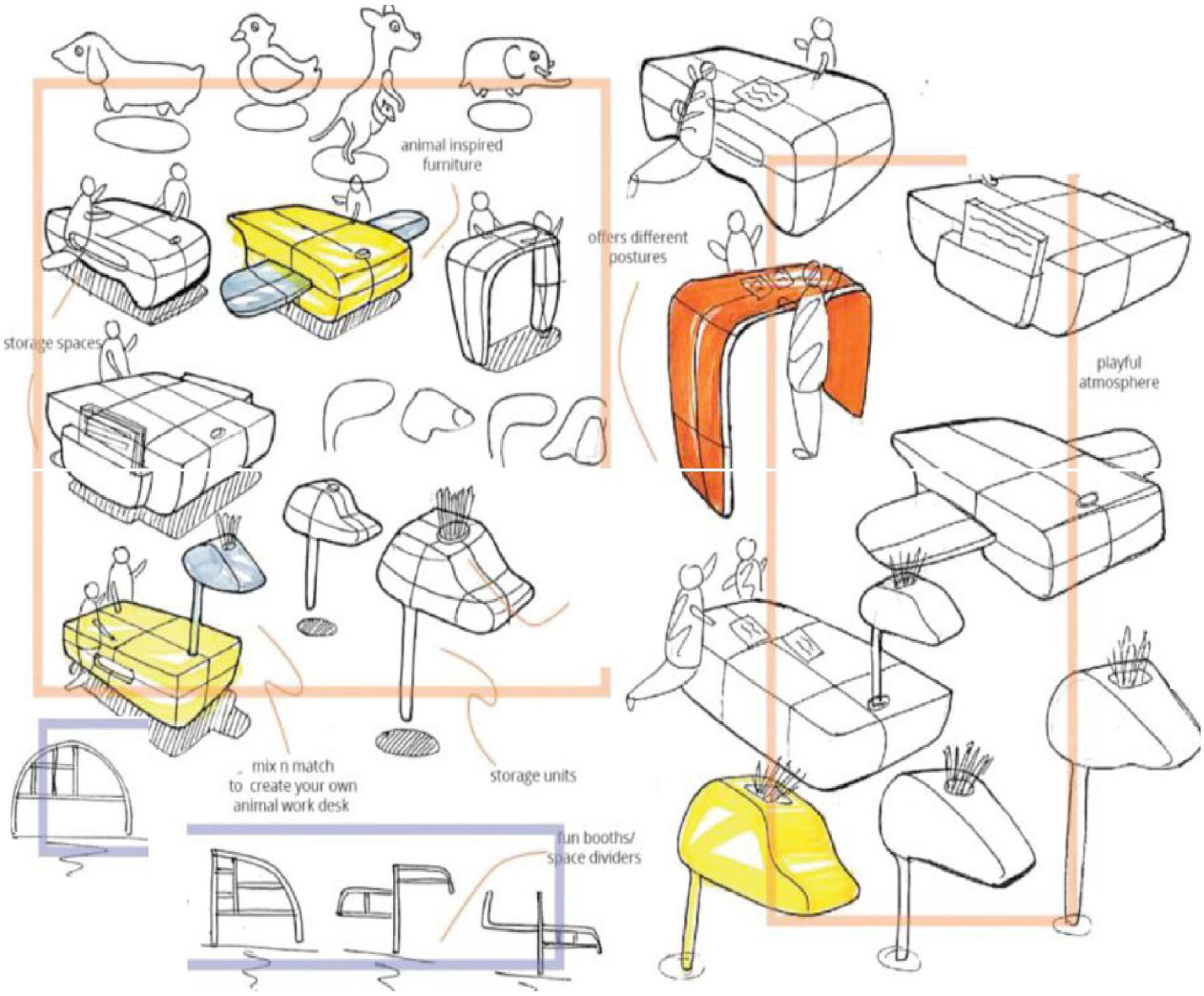
The first concept during the 'exploration phase' of integrating furniture with blocks was inspired by the strong inclination of children towards animals. When asked by children, what kind of characters, books or movies they like, most of their responses involved some kind of an animal. They loved reading books with animal characters; they played with animal puppets and dolls and engaged in a lot of role-play by becoming animals and imitating their sounds. It definitely came across as an exciting and fascinating character for the kids. Most of such furniture that came across in research was either too literal in the design or heavy which did not meet the design requirements

[27] Different kinds of Play Blocks at Margaret's House Kindergarten Classroom

of this thesis. This led to explorations and sketches of flexible, easy to move and playful furniture forms that were inspired by animals. Different forms were sketched inspired from different kinds of animals; there were desks of different heights to accommodate for different learning requirements. Storage areas were incorporated in the design in creative ways for keeping things or making built-in pockets on the sides for keeping books, papers etc. The system overall inspired standing, floor seating, sitting on desks, individual workspaces as well group workspaces.

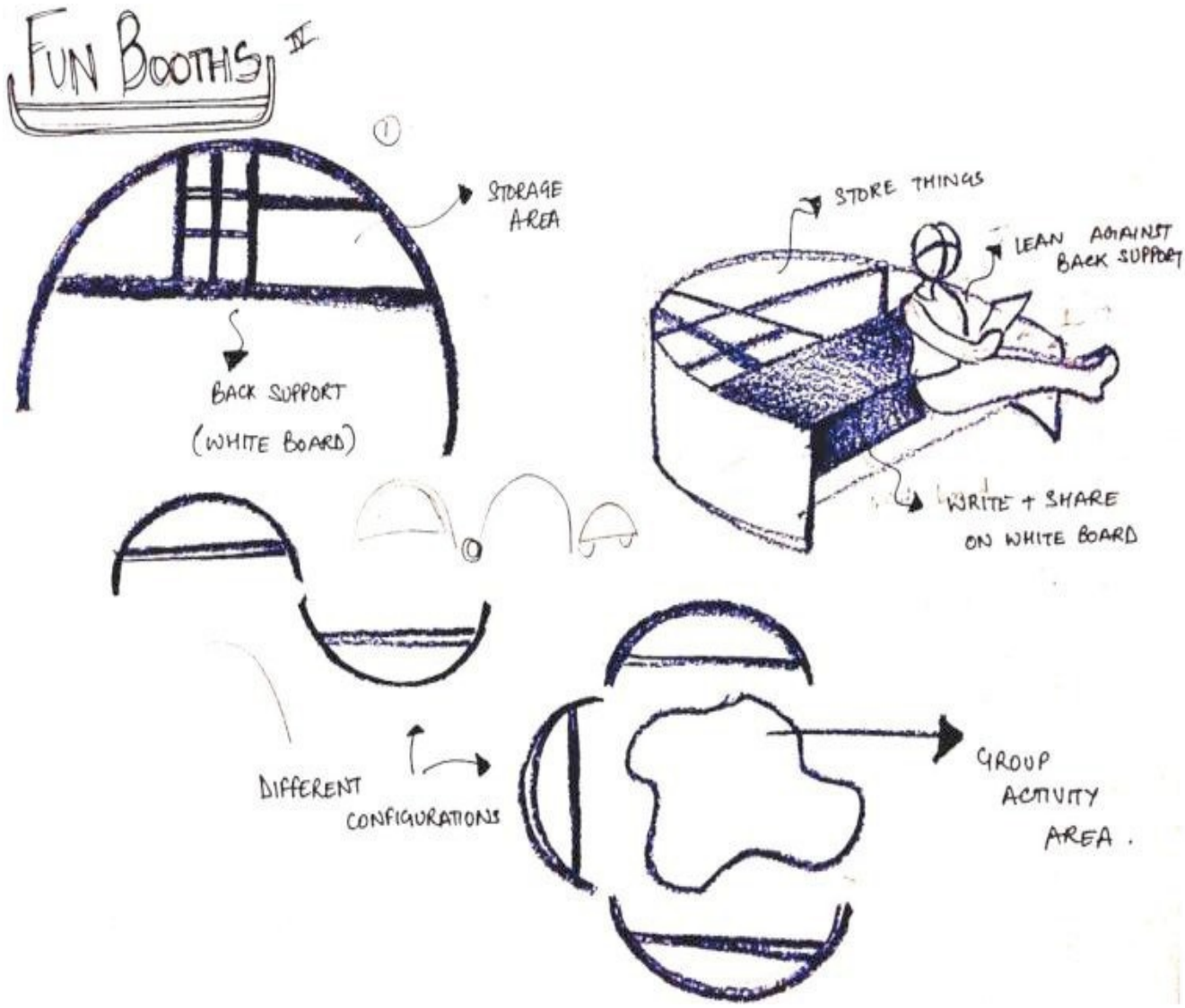


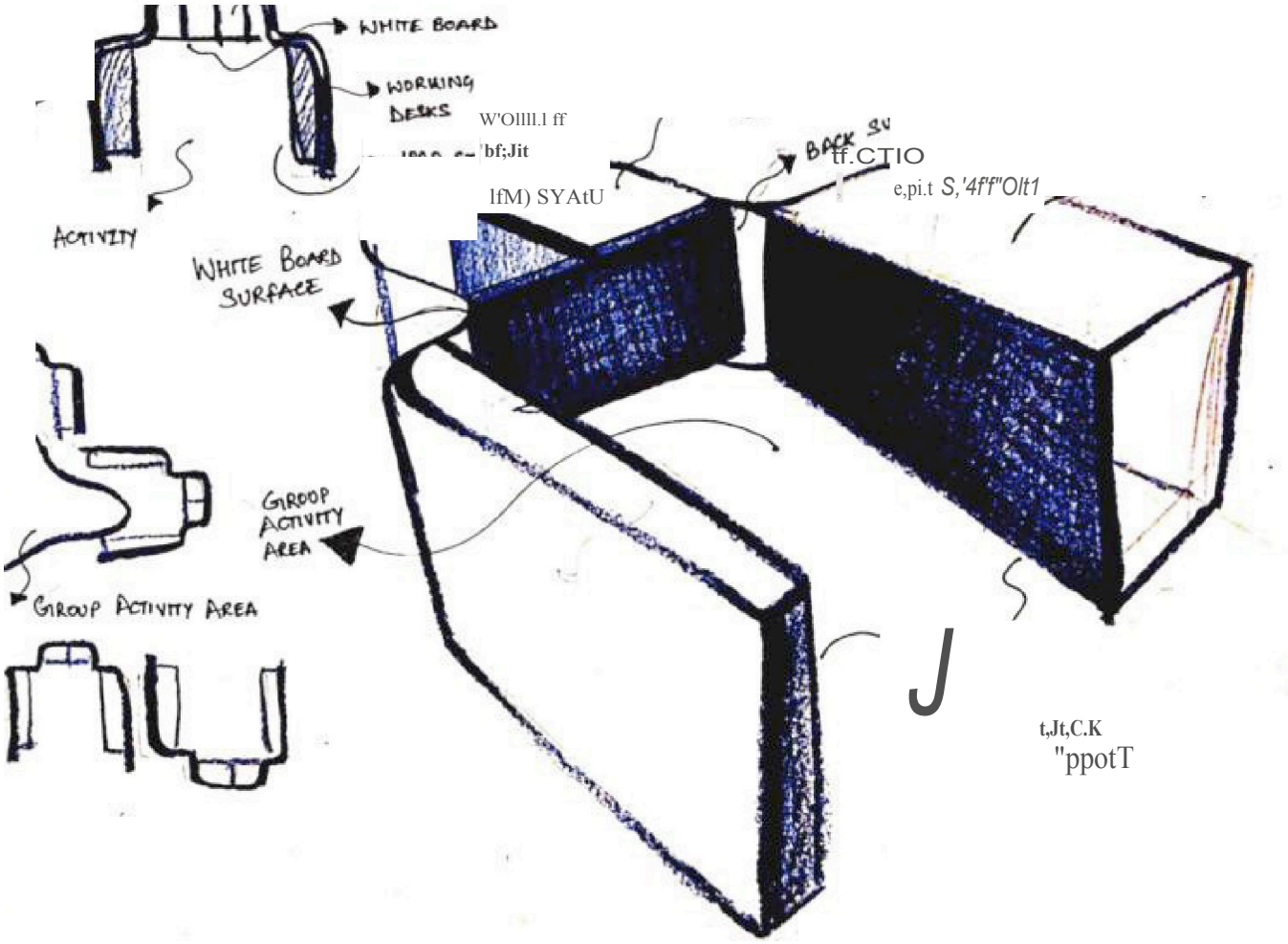

THESE BASES COME WITH DIFFERENT SETS OF 'HEADS' (provides storage)
CONTAINER
PEN / PENCIL HOLDER 'HOLES'
MARKERS HOLDER


animal inspired
furniture
offers different
postures
storage spaces
playful
atmosphere
mix n match
to create your own
animal work desk
storage units
fun booths/
space dividers

Concept 2: Furniture Blocks designed using Modularity

For the second concept, the modularity of blocks was taken as inspiration to create a system of ‘fun booths’ or ‘learning stations’. These booths could support individual learning as well be kept together in any number to create bigger workspaces for groups. They provide a sense of privacy for working alone, at the same time the outer curve of the form makes the space collaborative when arranged together. The workstation has slabs that form sections of different sizes that can be used for storing different materials. The concept did not seem very playful overall and was losing the essence of play blocks that was supposed to be the primary inspiration while designing for this classroom.

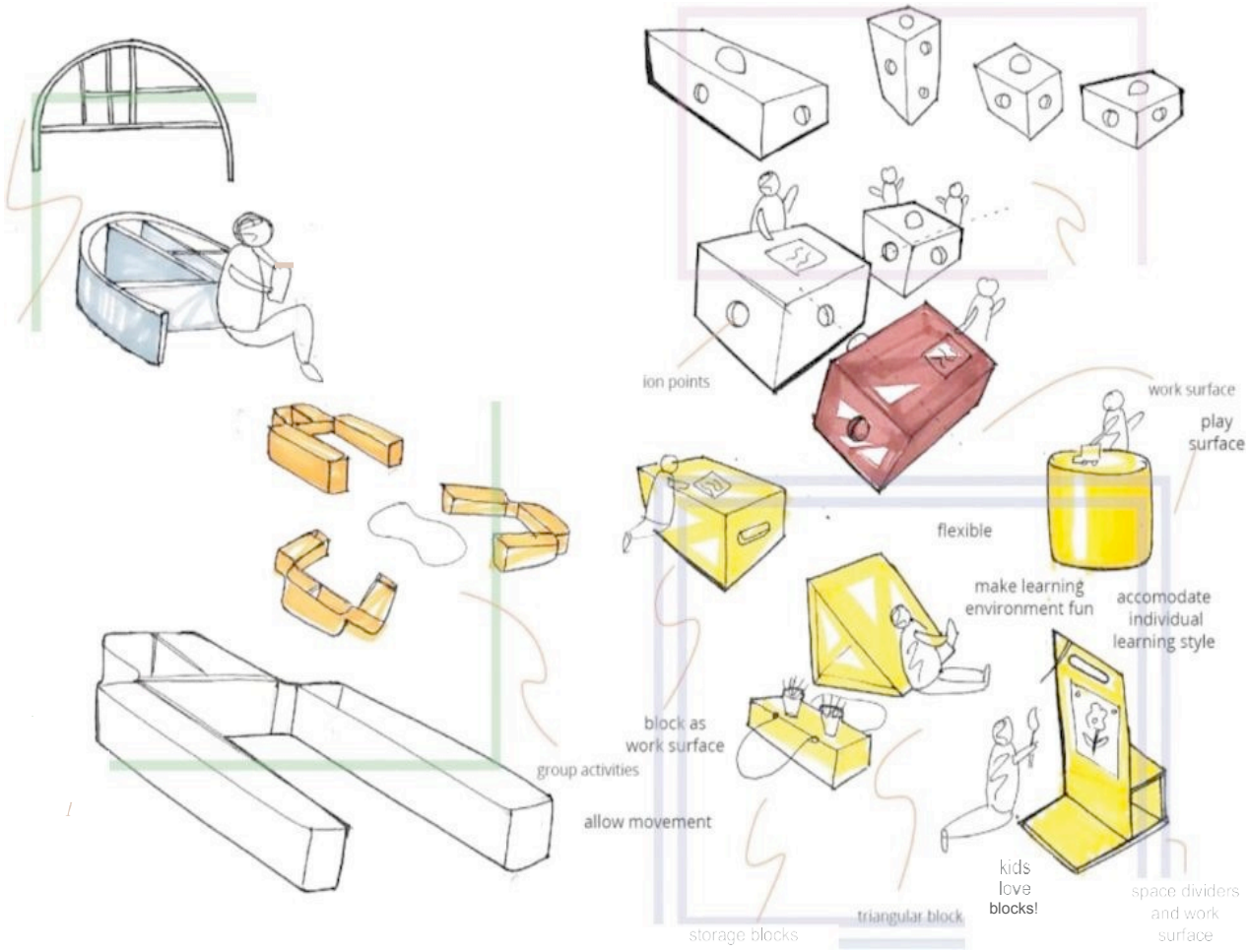




W'OIlll.1 ff
bf;Jit
lfM) SYAtU
tf.CTIO
e,pi.t S,'4f'f"Olt1
t,Jt,C.K
"ppotT

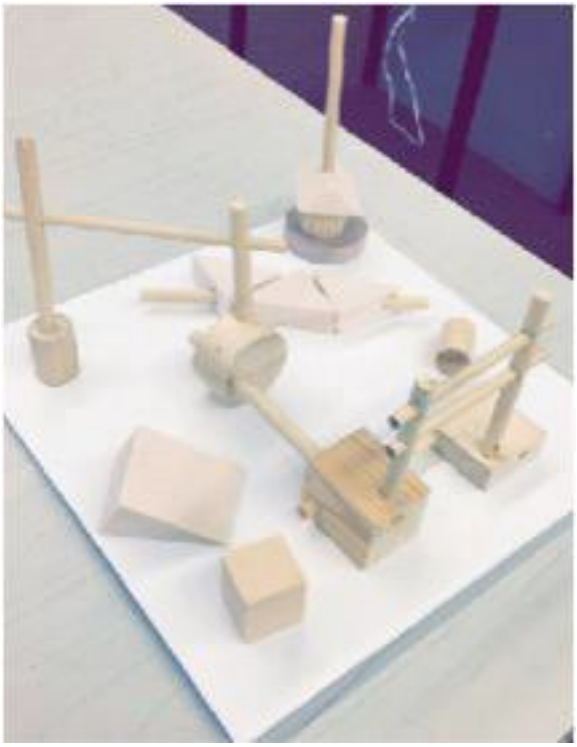
Concept 3: Furniture Blocks Connection System

Since blocks played an important role in directing the course of the thesis, for the third concept it was decided to derive inspiration from the form factor of blocks. The main point of focus here was to make a system where these blocks serve as furniture, stay true to the design requirements but also connect with each other through a connection system so that they can be used like actual play blocks to build life size structures. To solve this, there were holes made on certain sides of the blocks that could be connected to other blocks by dowels. While the idea seemed exciting, the form of the blocks especially with holes on the sides was limiting the function of the blocks to be used as furniture.



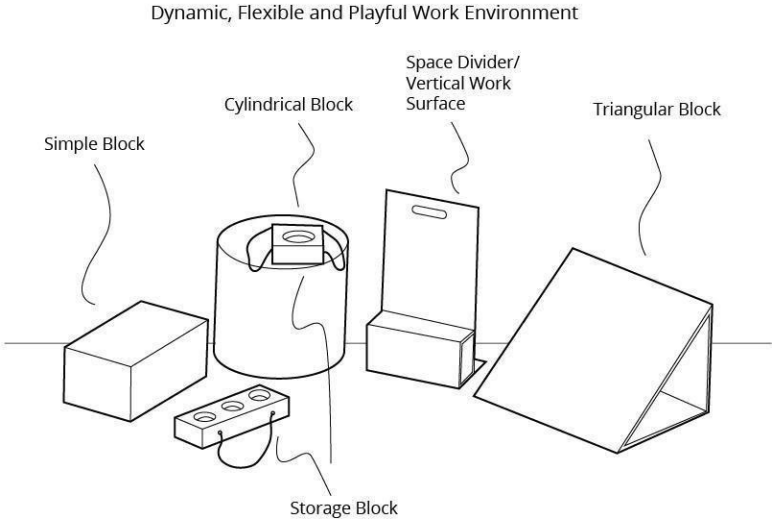
Concept 4: Flexible, Playful and Accommodating Furniture Blocks

Concept 3 stated above seemed exciting and playful. To solve the problem of form limiting the function, it was advised by the design mentors to shift the focus from connecting the blocks to designing them to serve as furniture that supports different kinds of learning. The idea of holes and connectors was dropped and the focus was to create simple forms for blocks that make the learning space flexible and are still playful. The five kinds of blocks that were taken from the concept stage to prototyping stage were cube, triangle, cylinder, a workspace divider and storage cups holder, keeping in mind the needs of the classroom and after observing how children sat around desks or the rug. The cube block provides different heights for sitting. When kept flat on the ground it can be used as a working surface or desk. It can be used by an individual for working or can be kept in groups to form a collaborative workspace. The triangle block can be kept against a wall or the cube block and can be used to lean against to read a book or rest. The cylinder can be kept on the ground on the flat surface and be used as a higher stool. Rolling on it becomes a fun activity too! The workspace divider can be placed on the ground and provide a vertical work surface in addition to horizontal desks. These can also be used to work privately by one individual or kept together to make a group workspace. The storage cups holder adds playfulness and delight as they can be hung anywhere and can be used in conjunction with the blocks. They support the learning taking place around the system of blocks by providing easy access to pens, pencils, crayons and other stationary.



28

Final Concept -Learning Blocks



6. Prototyping

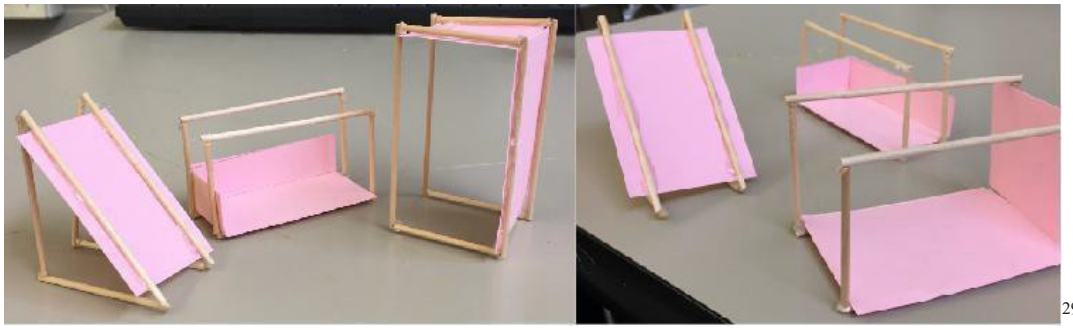
After finalizing the concept, the prototyping phase began. It started with scavenging through the design shop for sheets of plywood and Styrofoam cubes and playing around with them in the studio.

---

[28]Early Ideation for Concept Development

This exercise gave a good starting point and a sense of spatial range to begin with. It also provided a fast way of communicating ideas to peers and professors and get quick feedback and make changes accordingly. I referred to 'The Measure of Man and Woman: Human Factors in Design' by Henry Dreyfuss to understand the ergonomics of sitting, standing and leaning postures of children in the age range of 4-5 years. The key takeaways from the study were:

- Sitting position
- Height of table
- Height of chair
- Height of kids
- Weight of kids

 [29]

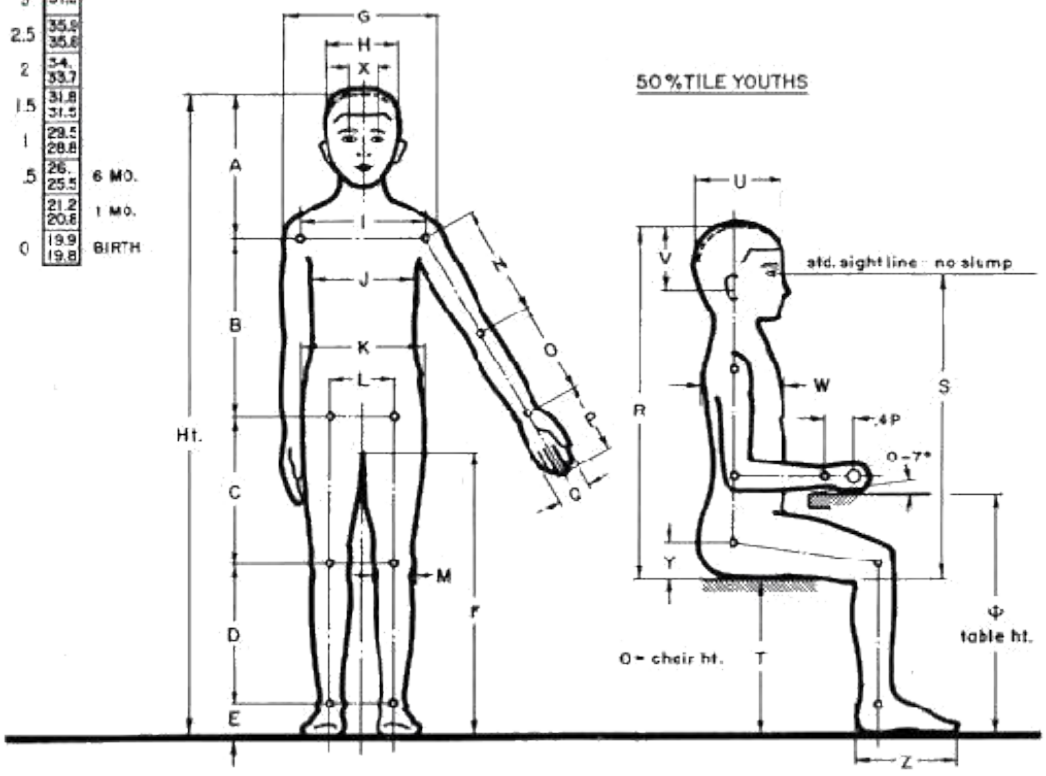
[29] Early Prototypes to understand Form and Scale

C

ANTHROPOMETRIC DATA – MALE AND FEMALE CHILDREN

Top figure in box is data for boys, lower figure is for girls, and one figure applies to both.

Age	Ht.	Wt.	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	Θ	Φ
17	68.2 63.6	138. 119.	12.2 11.5	20.7 19.7	16.3 15.1	15.6 14.4	3.4 3	31.7 28.9	15.7 14.4	6. 5.8		13.2 12.1	12.9		3.7	12.3 11.5	10. 9.1	7.6 7.		35.3 33.5	31.3 29.5	17. 16.	7.3 7.6	5.2 5.	7.6 6.7		2.9 2.8	10.1 9.5	16°	27°
16	67.2 63.5	132. 118.	11.8 11.3	20.5 19.8	16.2 14.9	15.5 14.5	3.3 3.	31.5 28.9	15.2 14.3	6. 5.8		12.9 12.1	12.7 12.8		3.7	12.2 11.7	9.9 9.1	7.6 7.		34.5 33.4	30.5 29.4	17. 15.5	7.6 7.3	5.2 5.	7.4 6.9		2.8 2.7	9.8 9.4		
15	65.6 63.2	122. 115.	11.1	20.1 19.7	15.9 14.9	15.2 14.5	3.3 3.	31. 28.9	14.7 14.2	5.9 5.8		12.4 11.9	12.3 12.7		3.7	11.9 11.5	9.7 9.	7.5 7.		33.4 33.	29.4 29.	16. 15.5	7.5 7.3	5.1 5.	7.2 6.8	2.3	2.7	9.5 9.3	15	25
14	63. 62.3	109. 108.	10.9 11.	19.2 18.8	15.1 15.2	14.6 14.3	3.2 3.	29.7 28.5	14.1 14.	5.9 5.7	11.	11.6 11.4	11.6 12.3	5.6	3.6	11.4	9.3 9.	7.2 6.9	3.	32.1 32.4	28.1 28.4	16. 15.	7.4 7.3	5.1 5.	6.9 6.7	2.2 2.3	2.6	9.1		
13	60.5 60.6	96. 100.	10. 10.2	17.9 19.	15.5 14.3	13.9 14.1	3.2 3.	28.5 28.2	13.5 13.6	5.8 5.7		11. 11.1	11. 11.8		3.5	10.7 11	8.8	6.8		30.9 31.5	26.9 27.5	15.5 15.	7.4 7.2	5.1 5.	6.6 6.5	2.2	2.5	8.9	14	24
12	58.2 59.	86. 90.	10.8 10.6	17.1 17.9	13.9 14.3	13.3 13.5	3.1	27.3 27.4	13.	5.8 5.7		10.6 10.7	10.6 11.2		3.4	10.3 10.6	8.4 8.5	6.6		29.9 30.3	25.9 26.3	14.5 14.7	7.3 7.2	5.1 4.9	6.4 6.3	2.2	2.6	8.6 8.5		
11	56.2 56.5	77. 79.	10.6 10.4	16.5 16.8	13.3 13.4	12.7 12.9	3.	26.1 26.3	12.6 12.4	5.8 5.7	10.5	10.2 10.3	10.1 10.5	5.	3.3	9.9 10.	8.1	6.3 6.4	2.8	29.2 29.1	25.2 25.1	14. 14.4	7.3 7.1	5. 4.9	6.2 6.	2.2	2.5 2.4	8.4	13	22
10	54.3 54.2	71. 70.	10.6 10.4	15.9	12.7	12.2 12.3	2.9	25.1 25.	12.3 12.	5.8 5.6		9.9	9.8 10.		3.2	9.5	7.8 7.7	6.1		28.5 28.2	24.5 24.2	14. 13.	7.3 7.1	5. 4.9	6. 5.7	2.2 2.1	2.5 2.4	8.3		
9	52.4 52.	64. 63.	10.7 10.3	15.1	12.2 12.1	11.6 11.7	2.8	23.9 23.8	11.8 11.5	5.7 5.6		9.5	9.1 9.5		3.1	9.1	7.4 7.3	5.9 5.8		27.7 27.4	23.7 23.4	13.5 13.	7.2 7.	5. 4.9	5.8 5.5	2.1	2.4 2.5	7.9 8.	12.5	20.5
8	50.4 50.	58. 57.	10.6 10.2	14.5 14.4	11.5	11.1	2.7	22.7	11.4 11.1	5.7 5.6	9.2	9.2	9. 9.1	4.4	3.	8.7	7.1 6.9	5.7 5.6	2.5	27. 26.6	23. 22.6	13. 12.5	7.2 7.	5. 4.9	5.7 5.4	2.1	2.4 2.5	7.7		
7	48.2 47.9	53. 51.	10.7 10.3	13.6	10.8 10.9	10.5	2.5	21.5 21.4	10.9 10.7	5.7 5.5		8.8	8.7 8.8		2.9	8.2	6.8 6.6	5.4 5.3		26.1 25.7	22.1 21.7	12. 11.5	7.1 6.9	5. 4.8	5.5 5.4	2.1	2.4	7.4	11	18.5
6	46.1 45.8	48. 46.	10.8 10.4	12.7	10.3	9.8 9.9	2.5	20.2	10.4 10.2	5.6 5.5	8.5	8.5	8.3 8.4	4.1	2.8	7.6	6.1 6.2	5.1	2.3	25.4 25.	21.4 21.	11.5 11.	7.1 6.8	4.9 4.8	5.5 5.3	2.	2.4	7.		
5	43.9 43.6	43. 42.	10. 9.7	12.7	9.6	9.2	2.4	18.9 18.8	10.1 9.8	5.6 5.4		8.2	8. 8.1		2.7	7.	6. 5.9	4.9 4.8		24.5 24.3	20.5 20.3	11. 10.	7. 6.8	4.9 4.8	5.4 5.2	2. 1.9	2.3 2.4	6.8 6.6	10	17.5
4	40.9	38. 37.	10.4 10.5	11.1 10.9	8.8	8.4 8.5	2.2	17.2	9.7 9.4	5.6 5.4		7.9	7.4 7.7		2.7	6.4	5.6 5.4	4.7 4.6		23.5 23.1	19.5 19.1	9.5 10.	6.9 6.7	4.9 4.8	5.2	1.9 1.8	2.3 2.2	6.6 6.5		
3	37.5																													
2.5	35.9 35.8																													
2	34. 33.7																													
1.5	31.8 31.5																													
1	29.5 28.8																													
.5	26. 25.5	6 MO.																												
	21.2 20.8	1 MO.																												
0	19.9 19.8	BIRTH																												



Based on the ergonomic and mock up study and the measurements taken from the Kindergarten classroom at the Margaret's House, the following were decided as the measurements for the prototypes:

Cube:
Length 45 cm, Breadth - 30 cm, Height - 23 cm

Triangle
Base - 15.24 cm, Length - 25.4 cm, Hypotenuse- 29.6 cm

Cylinder
Diameter - 24 cm, Height - 46 cm

Space Divider
Vertical Base- Length - 76.2 cm, Breadth - 55 cm, Thickness - 1.27 cm
Horizontal Base- Length – 50 cm, Breadth- 55 cm, Thickness < 0.5 cm

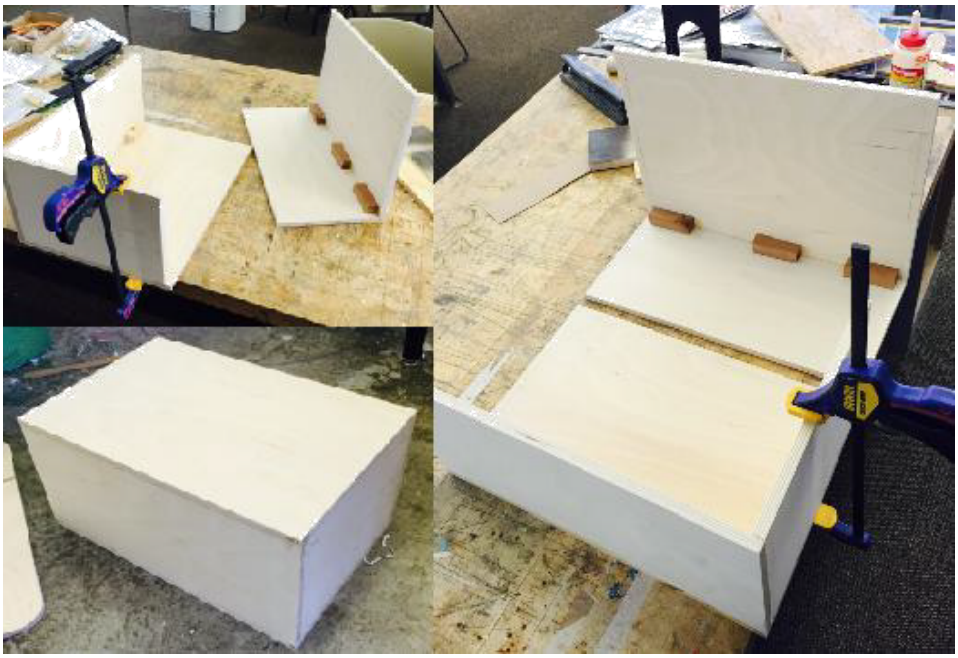
Storage Cup Holder:
Length - 55 cm, Breadth – 20 cm, Height – 7 cm

The blocks had to be light enough to be moved around easily to be able to make customized learning spaces and durable enough to support each child. Wood was chosen as the material for prototyping since the current furniture is made of wood and the new blocks would not be a huge departure from what the kids are already used to. Also, wood is durable enough to support the weight of children. Production wise, wood is cheaper and easy to manufacture. The blocks were made hollow to reduce the material used and to make the blocks lighter.
Baltic Birch wood was suggested as the **material** for prototyping as it looks elegant and aesthetically pleasant.

The prototyping phase was a great learning experience about woodworking techniques and new kinds of tools. It was a highly enriching experience and contributed greatly to my shop skills.

For the cube, wood with the above measurement was cut on the table saw and glued together using clamps and wood glue. For the triangle block, the three faces were cut with an edge of 45 degrees on the table saw and glued together with wood glue and clamps. For the space divider, the longest face was cut on the CNC machine due to the in-cut handle; while the rest of the faces were cut on the table saw and again glued together using clamps. The cylindrical block was made by cutting two circles from the Baltic Birch wood sheet on CNC and gluing them on the two ends of a PVC tube found in the design shop. The tube was later covered by a wood veneer sheet. The storage blocks were made by milling in circular hollows on the front face of the wooden blocks and drilling in two smaller circles all the way through the blocks on the side faces. Woolen ropes were then threaded through these holes and tied together in tight knots to serve as handles for the blocks. The yarns add a playful character to the blocks and provide a contrast of softness against hard surfaced wooden furniture. It is also easy to hold them and carry them anywhere around the classroom or hang them over the corner of the working surface.

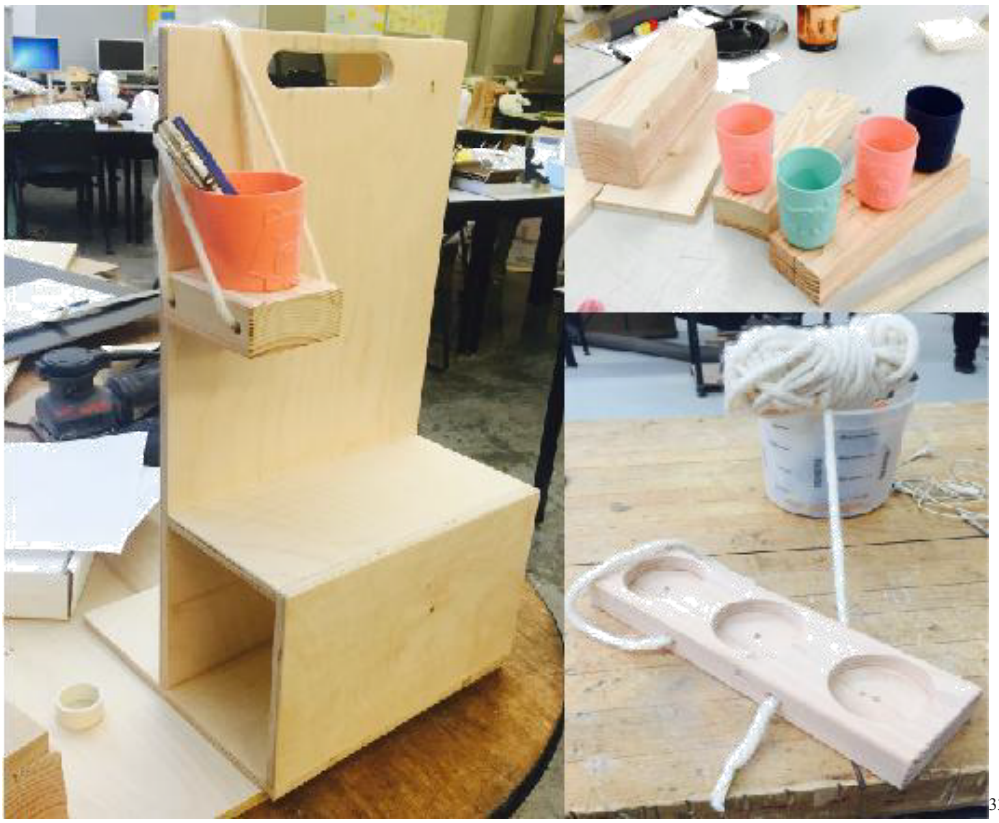
[30]Alvin R. Tilley, Henry Dreyfuss Associates, 'The Measure of Man and Woman: Human Factors in Design', (New York, 1959), 6

 [31]

 [32]

[31] Prototype in Development for the Cube Block

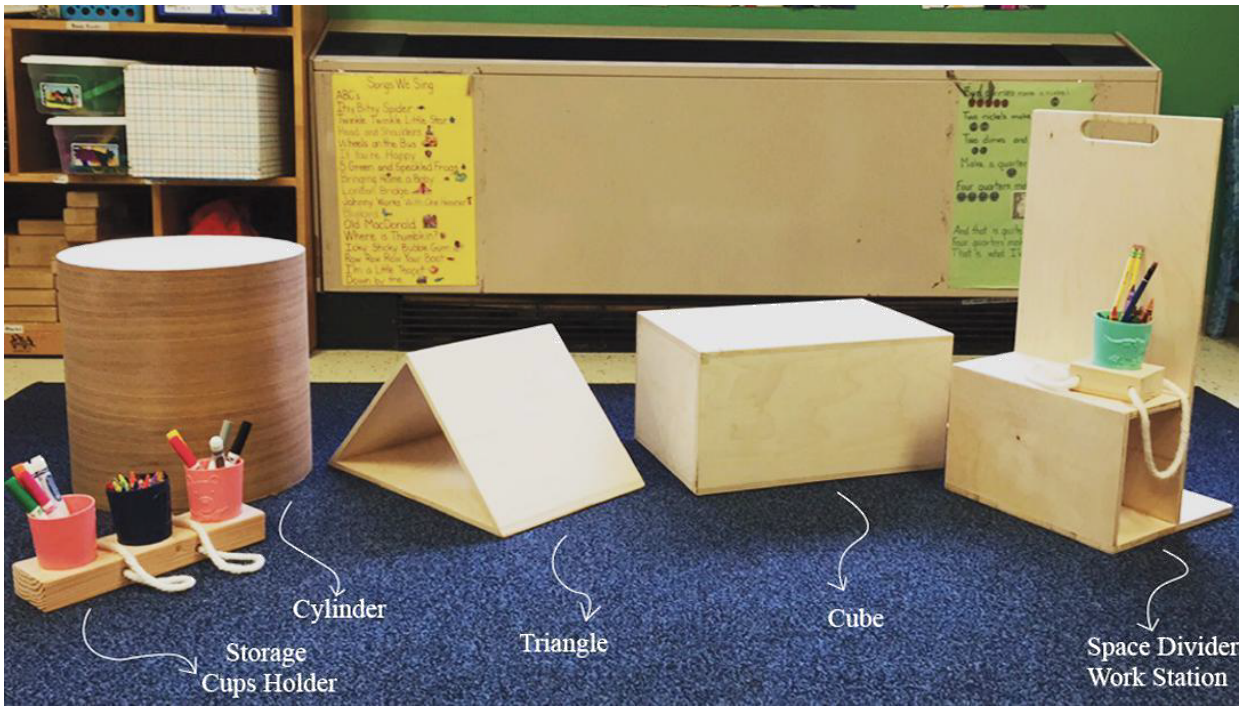
[32] Prototype in Development for the Triangle Block

 [33]

[34]

[33] Prototype in Development for the Space Divider

[34] Prototypes in Display at the Graduate Thesis Design Show, 2016



35

7. User Testing, Feedback and Future Steps

The prototypes were finished in three weeks and were taken over to the classroom at Margaret's House for testing. It was a rather fun and pleasantly surprising experience. The first reaction of the children was filled with confusion as they weren't expecting big blocks to be coming to their environments, and because they weren't told what these blocks were or did. The blocks were randomly distributed throughout the classroom in the open/empty spaces and the children were left to interact with them freely. What followed was a fun filled time where several interactions were observed which I, as a designer, had not expected or even thought of, along with some expected interactions.

Results and Future Steps:

Triangle Block: Expected interaction was to see children lean against it and read something or rest. It was interesting to see them stick sheets of paper on its faces and sketch on it.

Cylinder Block: Expected interaction was to see children sit on it and use it as a stool for sitting in groups and make collaborative workspaces or participate in group discussions. However, they used it in so many different playful ways such as rolling themselves on it, rolling their cars on it, attributing the cylinder as a 'hill' and racing their cars to the top. They also used the height of the cylinder as a base for 'building castles' on top of it. There was a lot of role-play built around it.

Space divider: This interaction was the most interesting and personally one of my favorites. While two children in the classroom were using it as a work station and writing and sketching on it, another child in the classroom laid it down on the ground, put a bean bag on it and made a little bed out of it!

Cube: The interaction with the cube was as expected, children sat on it and used it as a desk to write and draw.

---

[35]Final Prototypes at the Margaret's House Kindergarten Classroom

Integration: A lot of children combined all the blocks together and engaged in a lot of role-play. They sat on the space divider and kept the triangle on their laps and used their other blocks from the classroom to build a 'human train'.

The testing was a really enriching experience where the idea was put out in front of the users and put to test. While a lot of changes surfaced, they overall were very excited about the blocks and gave a positive feedback. They had a really good time playing with them and were upset when it was time to pack up and leave the classroom.

Some interesting key points that came up and would be worked upon in the future after user testing are:

- Though the blocks were consciously made hollow, they were still heavy for the users to move around easily. Changing the form factor of the blocks to reduce material usage and simplify geometry could be the starting point.

- Though all the joints were rounded and sanded thoroughly, the teacher pointed out that it would be better to further round the edges keeping safety in mind. Exploring 3D printed plastics as an alternative for joints would not only be safer but also make the product overall lighter solving the problem stated above.

- To cater to the unexpected interactions that were witnessed during the user testing, it would be worthwhile to integrate some kind of accessories with the blocks such as cushions, soft padding for seating, paper clips and hooks to hold papers etc.

- Since one of the main design requirements of the blocks is easy movement, for students and teachers, some sort of built in handles either cut into the panels of the blocks or an easy form sticking out would be good to explore.

Though the blocks were created with specific functions in mind, it was nice to see how the users gave these blocks different personalities and engaged in a lot of role-play. They made structures, hills, and trees out of them and created stories around them. They were not limited by the conventional tables and chairs and now had the freedom to not only perform their regular classroom activities but also add extra playfulness in them by creating stories around them. The environment around them was supporting unrestricted play and imagination and was contributing to making education a fun experience.

36

8. Conclusions

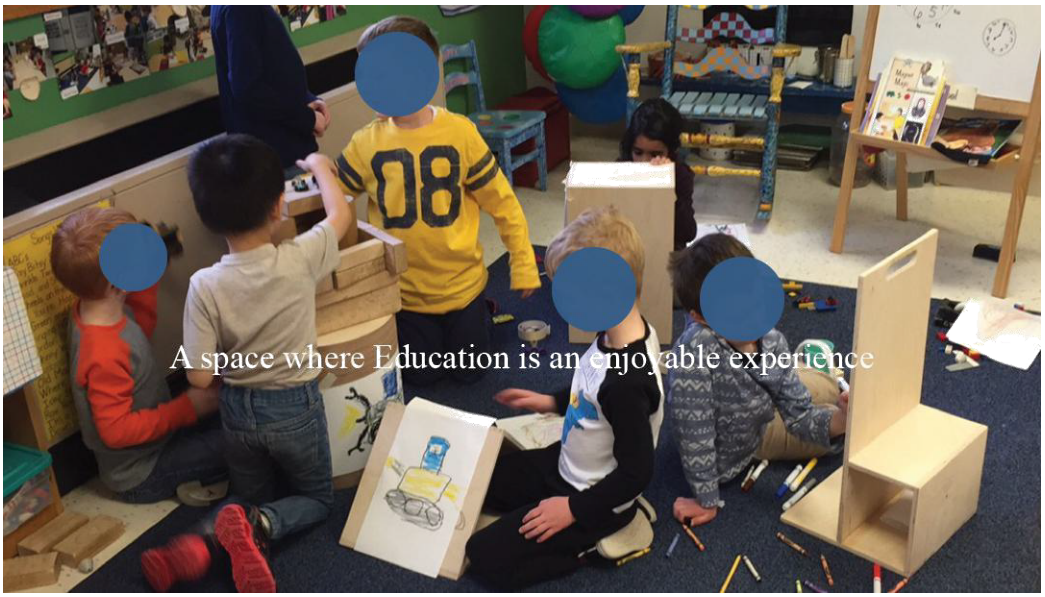
We all know the value and worth of education in our lives. With the human race reaching new heights and our society constantly evolving and changing, it is high time the Education system evolves to be at par with the changing times. We should realize that education being imparted at school should not be a 'one size fits all' and should move away from the conventional factory setting. Our differences make us unique and this diversity should be celebrated not undermined at schools. Though the classrooms have started adopting new tools and technologies, the overall essence of school education still remains the same where the role of the teacher and students, the classroom furniture and the classroom setting has not really evolved. Classrooms, present a critical design problem, both in terms of physical space and curriculum design, and yet remain one of the most neglected areas. Companies like IDEO and Herman Miller have recognized some of the issues and designed to solve the classroom challenges, however, there still remains a lot of potential and untapped areas in the Education sector that can utilize design thinking.

One of the areas where design for education is suffering drastically is empathetic design and designing from the point of view of the children. Most of the products designed for classrooms are pretty standard and designed keeping in mind the teachers and the school's staff rather than the direct users i.e. the children inside the classrooms.

This thesis aims at bridging this gap and has been designed keeping in mind that children are the primary users of the product while teachers being the secondary. The integration of play blocks and furniture would hopefully bring about the flexibility that is missing in classrooms as the users would be able to easily move around and create spaces according to their learning needs. Different form factors provide for accommodating diversity as each individual learns differently. While some prefer to sit straight and write, others prefer to lean back and read, and some others might prefer to sit in groups and narrate, draw, engage in movement or role-play. This system of blocks accommodates all of the above uses and more.

---

[36] Prototypes being User Tested with Kindergarteners at Margaret's House



The form factor might not be final and not be able to solve all the problems yet, but it definitely sets a platform for further research and exploration for solving some of the critical issues being faced by the learning process in the classrooms. Finally, aesthetically the form factor of blocks is familiar to the users and something they can associate with easily. They spend a large part of their day in the classroom playing with blocks, and this system increases the blocks in size providing the opportunity to make life size structure that encourages role play, boosts imagination and develops social skills. It also brings about a shift in the overall aesthetic of the classroom from being conventional and rigid to more playful and exciting. It was a delight working with Margaret's House and all the kindergarteners who were extremely supportive, patient and helpful throughout the process. The excitement shown by them for the first set of prototypes is definitely a driving force to continue working on this topic and develop more iteration for testing. It has been a great learning experience that has set a platform for a journey that would hopefully yield great outcomes in the future.

Bibliography

Reda, Mohamed. "Top 10 Reasons why Education is Extremely Important ". *LinkedIn*. Published April 9, 2015. https://www.linkedin.com/pulse/top-10-reasons-why-education-extremely-important-mohamed-reda/

Vidyarthi, Kavya. "Top 15 Reasons Why Education is Extremely Important". *listsurge*. Published September 1, 2015. https://listsurge.com/top-15-reasons-education-important/

Lynch, Matthew. "10 Reasons the U.S Education System is Failing". Published August 27, 2015. http://blogs.edweek.org/edweek/education_futures/2015/08/10_reasons_the_us_education_system_is_failing.html

Powell, Andy. "We Need An Education System That Excites Children". *Imaginative Minds Group TeachingTimes.* https://www.teachingtimes.com/articles/revolution-education-system.htm

"Common Core State Standards Initiative". *Common Core State Standards Initiative.* http://www.corestandards.org/

Meador, Derrick. "What are some Pros and Cons of the Common Core State Standards? ". *ThoughtCo*. Updated May 31, 2017. https://www.thoughtco.com/common-core-state-standards-3194603

"Is the Montessori Curriculum Effective?". *Concordia University*. Updated January 7, 2016. http://education.cu-portland.edu/blog/curriculum-instruction/is-the-montessori-curriculum-model-effective/

Brown, Laura Lewis. "Comparing Preschool Philosophies: Montessori, Waldorf and More". *PBSparents.* http://www.pbs.org/parents/education/going-to-school/choosing/comparing-preschool-philosophies-montessori-waldorf-and-more/

"Preschool Philosophies, A to Z". *GreatSchools Staff.* Published May 15, 2015. https://www.greatschools.org/gk/articles/preschool-philosophies/

"The Impact of School Environments: A Literature Review", page 26 figure 11. *The Center for Learning and Teaching, School of Education, Communication and Language Sc ience, University of Newcastle.* http://citeseerx.ist.psu.edu/viewdoc/download;jsessionid=195B2B0D479CAAC7057E6BBE1EAA9DB8?doi=10.1.1.231.7213&rep=rep1&type=pdf

Howton, Robyn. "Turn your classroom into a personalized learning environment". *ISTE*. Published August 16, 2017. https://www.iste.org/explore/articleDetail?articleid=416

Bradley, Laura. "Collaboration on Wheels: 21st Century Classroom Furniture at Work". *edutopia*. Published March 9, 2014. https://www.edutopia.org/discussion/collaboration-wheels-21st-century-classroom-furniture-work

"The Brain Made Simple". http://brainmadesimple.com/left-and-right-hemispheres.html

Jensen, Eric. The Learning Brain. California: Turning Point Publishing, 1995.

N, John. "The Theory of Multiple Intelligences and AI". *EDGYLABS*. Published December 25, 2016. https://edgylabs.com/multiple-intelligences-ai/

Smith, Mark K. "Howard Gardner, multiple intelligences and education". *Infed.* http://infed.org/mobi/howard-gardner-multiple-intelligences-and-education/

Callan, Roger. "Education: Would you like to sit on the floor?". *INDEPENDENT*. published April 7, 1999. http://www.independent.co.uk/news/education/education-news/education-would-you-like-to-sit-on-the- floor-1085806.html

Gudritz, Lindsey. “6 Types of Play Important to Your Child’s Development”. *healthline*. Published June 20, 2016. http://www.healthline.com/health/parenting/types -of-play#1

Rock, Amanda. “10 Types of Play Important to Your Child’s Development. *verywell*. Updated July 21, 2017. https://www.verywell.com/types-of-play-2764587

Schoeneck, Angie. “Integrating Technology in Active Learning Spaces”. *Ideas+INSPIRATION*. http://ideas.demco.com/trends-topics/spaces/integrating-technology-active-learning-spaces-2/

Tilley, Alvin R, Henry Dreyfuss Associates. The Measure of Man and Woman: Human Factors in Design. New York, 1959.